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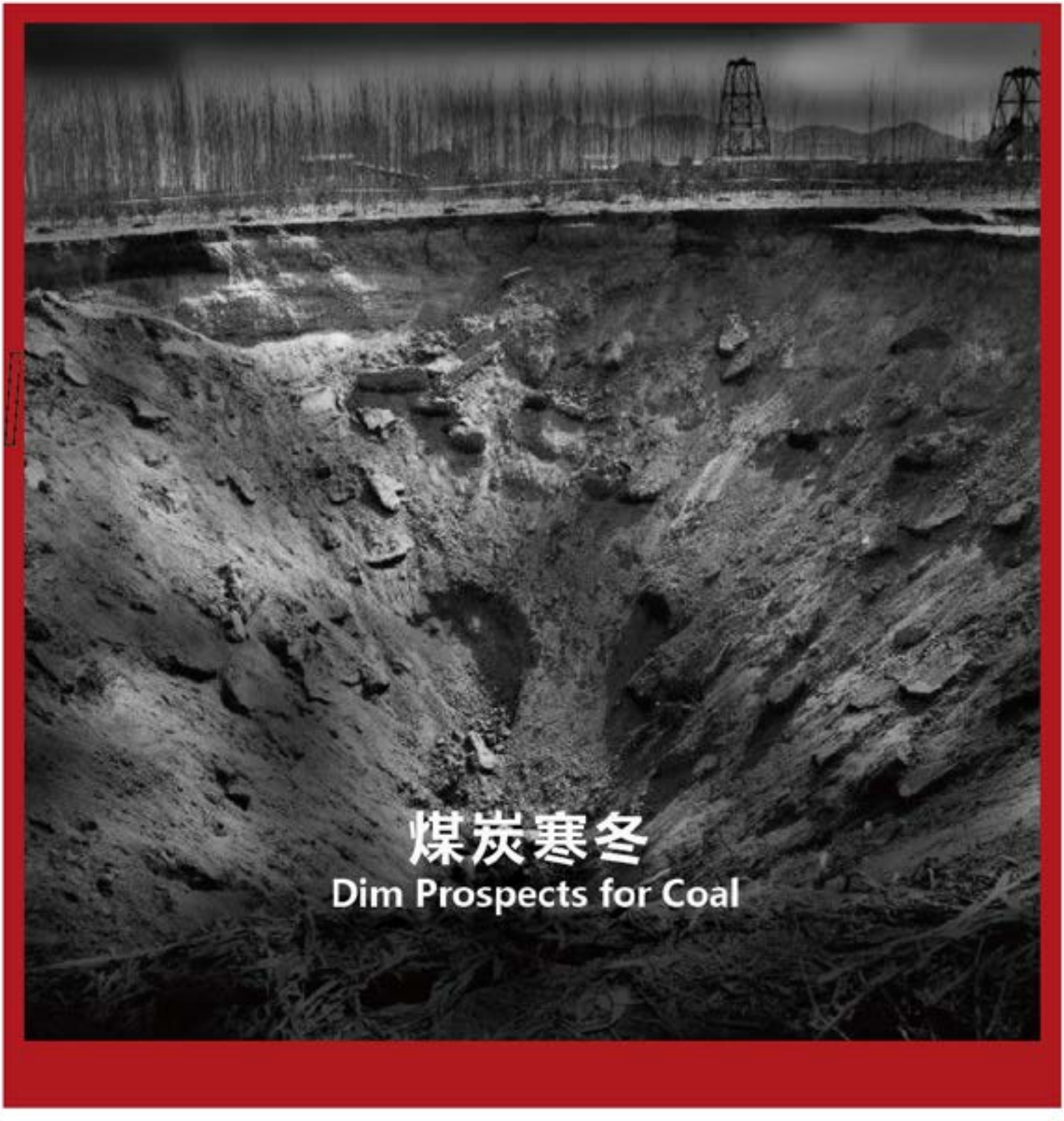

煤炭寒冬
Dim Prospects for Coal

总编　伊莎贝尔·希尔顿

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煤炭寒冬

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中国煤炭消费连续三年下降

国家统计局最新发布的数据显示，中国煤炭消费量连续三年下降，煤炭消费顶峰似已过去。

□ 冯 灏 唐大旻

得益于可再生能源投资的增长，中国煤炭消费量在2016年继续下降4.7%

中国国家统计局今天（2 月 28 日）上午公布了《2016 年国民经济和社会发展统计公报》，各个重点行业的成绩单同时晒出，引人注意的是，煤炭消费量和生产量皆实现连续三年下降，且下降率双双再创新高，分别为 4.7% 和 9.4%。

对于中国煤炭消费是否已经达峰，学术界并没有一致的看法，但这一最新数据似乎给煤炭消费已于 2014 年前后达峰的看法提供了重要的证据。

煤炭需求连续三年下降

按照统计局数字，中国煤炭消费量在 2014 年首次下降 2.9% 后，相继于 2015 年和 2016 年继续降了 3.7% 和 4.7%，在 3 年的区间内年度数据降幅呈逐年增加态势。但这是否意味着加速下降已成趋势呢？

中国社会科学院数量经济与技术经济研究所的秘书长刘强告诉中外对话，观察煤炭消费的月度数据可以发现，下半年煤炭的消费量及价格均有大幅波动，呈现出前低后高的走势，虽然抬头的势头并不强

劲，但仍然引起政府及业界关注。2017年1月，4个政府部门联合表示，将考虑以调控煤矿生产工作日为手段建立煤炭价格异常波动预警机制。

针对2016年煤炭价格的大幅波动及下半年的部分抬头，刘强指出，因为煤炭是和工业生产密切相关的行业，更准确地说，是和煤耗工业密切相关，政府为刺激经济，加大基础设施投资，钢铁、建材等高耗能行业需求在下半年有所增加。

此外，不同机构也对4.7%的降幅本身做出了其他解读。绿色和平按照能源消费总量和煤炭在能源结构中的比重计算得出，2016年中国来自煤炭的能源消费量下降幅度为1.3%。该机构认为这可能是由于煤炭质量的提高，也可能是数据偏差所致。而1.3%的降幅与今年1月中国煤炭工业协会发布的2016年全国煤炭消费降幅一致。

但无论怎样计算，中国煤炭消费总量连续三年下降的趋势已被坐实。对于这一趋势背后的原因，国际能源署能源供应部门负责人Tim Gould此前表示，钢铁、水泥等高耗能行业不再是未来中国经济增长的主要动力。国际能源署2016年调整了对于中国煤炭需求的预测，在《世界能源展望2016》中提出，中国煤炭需求在2013年就达到了峰值，而此前一年，其预测还是2020年。

煤炭的清洁替代

国际能源署能源市场和安全部门负责人贞森惠祐此前表示，中国的经济增长和煤炭需求之间的正相关已经有所削弱，而能源结构的多元化是其中的重要原因。

厦门大学中国能源经济研究中心主任林伯强表示，煤炭消费与经济增长之间仍然高度相关，2016年中国能源消费的降低是因为经济结构的转型和清洁能源的增加。在任何情况下中国的能源消费结构都将继续改善，煤炭在整体能源消费中的比重会持续降低。

根据能源“十三五”规划，国家发改委、能源局定下目标，将能源消费总量控制在50亿吨标准煤以内，其中煤炭消费总量控制在41亿吨以内。根据规划，2020年，非化石能源消费比重提高到15%以上，煤炭消费比重降低到58%以下。

具体到2017年，能源局提出，全国能源消费总量控制在44亿吨标准煤左右，非化石能源消费比重提高到14.3%左右，煤炭消费比重下降到60%左右。

煤炭需求加速下降是否可持续

能源视角，尤其是能源消费是分析经济状况的重要指标，而在中国，能源的关注点又长期体现在煤炭上。

2016年中国经济保持了6.7%的经济增长速度，而能源消费总量仅增长1.4%。国务院发展研究中心产业经济研究部研究室主任许召元指出，这体现出我国能源消费总量的增长速度持续降低，能源消费与经济增长“脱钩”的趋势明显。据他统计，2001-2012年，我国GDP年均增长10.2%，能源需求平均增长8.7%。而2013-2016年，GDP年均增长7.2%，但能源需求仅年均增长2.0%。

许召元表示，支撑高耗能行业增长的投资增长速度已经显著降低，今后几年不大可能明显反弹，中国经济“L”型增长的特点也决定了不可能有较强的能源需求反弹。在今后几年中，煤炭消费反弹的可能性并不大，更可能的是维持一段煤炭高消费的平台期，呈现平稳或缓慢下降的趋势。

另外，中国面临的资源环境压力必然会导致今后几年高耗能行业的发展继续受到限制。2017年开年，在广受诟病的京津冀和因环境受到好评的珠三角，都可以看到明显的控制煤炭消费增长的信号。

2017年元月，北京、河北、天津三地两会相继召开，政府工作报告中，继续部署新的压减煤炭消费任务均被提到。污染相当严重的河北要求今年削减煤耗600万吨以上，而整个京津冀区域压减煤炭消费量将达1000万吨以上。南部省份广东省也提出全省煤炭消费控制在1.75亿吨以内的目标，珠三角地区煤炭消费总量负增长。

冯灏，中外对话研究员
唐大旻，中外对话北京办公室资深编辑

China's coal consumption drops for third year

New data suggests that China is moving further away from coal as a primary energy source, a trend experts believe is unlikely to be reversed

□ Feng Hao Tang Damin

New research reveals that China burned 4.7% less coal in 2016 than in the previous year, meaning that annual coal consumption has dropped for the third consecutive year since 2014.

The newly released data by the National Bureau of Statistics raises hope that China is on track to reduce its toxic air pollution and continue battling climate change.

Previously, China's coal consumption dropped 2.9% and 3.7% year-on-year in 2014 and 2015, respectively, ending a streak of rapid consecutive growth from 2000 to 2013.

The new data consolidates a view among energy sector observers that China's coal consumption already peaked before 2014, much earlier than previous projections that placed it between 2020 and 2040.

Disputed numbers

However, the 4.7% figure is itself disputed. Greenpeace said the drop in the number of physical tonnes of coal burned differs from actual energy units produced from coal burning, which fell by merely 1.3% in 2016.

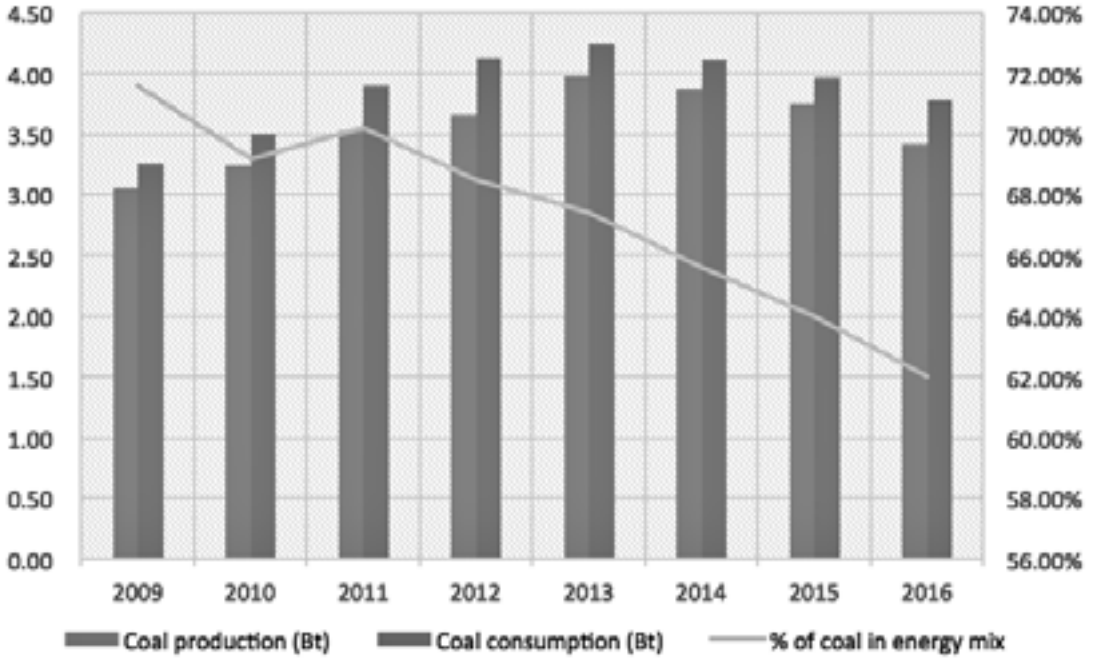
The difference can be attributed to either a major improvement in coal quality or discrepancies in the data. The 1.3% figure echoes a previous calculation by the China Coal Industry Association in January 2017. However, no doubt was cast on the fact that the weight of coal in the energy mix dipped to 62% from 64% in 2015.

This means China stands a better chance of achieving its objectives of keeping coal consumption at or below 4.1 billion tonnes, and of keeping the weight of coal in the energy mix at no more than 58% by end of 2020, which are embedded in the country's 13th Five-Year Plan for energy.

Tim Gould, head of the Energy Supply Outlook Division at the International Energy Agency, attributed the trend to shifts in the main drivers of China's economy, from energy-intensive steel and cement manufacturing to light industry, service sectors and transportation.

Transformation in the economic structure has also led to increased energy efficiency. In 2016, China's economy grew 6.9% while total energy consumption grew only

China's coal production, consumption and share of the energy mix, 2009-2016



Source: chinadialogue (based on figures published by the National Bureau of Statistics)

1.4%, noted Xu Zhaoyuan, a researcher at the Development Research Centre affiliated with China's State Council.

Xu added that China's economic growth seems to have been significantly less attached to energy consumption since 2013, with average annual GDP growth calculated at 7.2% and energy consumption hovering around 2%.

Possibility of a rebound

A closer look at the statistics reveals a U-shaped trend occurring last year, as shown by a steady increase in monthly coal consumption towards the end of 2016, said Liu Qiang, secretary general of the Institute of Quantitative and Technical Economics, part of the Chinese Academy of Social Sciences.

This is due to a surge in government-led investment into infrastructure construction aimed at reinvigorating the sluggish economy, Liu added.

The effect was amplified by private capital rushing in in response to the government initiative, noted Xu Zhaoyuan.

This adrenaline shot in infrastructure investment clashed with the government's ongoing campaign to shed excess coal extraction capacity, which included capping the annual operation time of coal mines. As a result, China increased coal imports by 25% year-on-year in 2016 to fill the gap between coal supply and demand.

However, experts told *chinadialogue* that a fundamental rebound in coal consumption is unlikely.

Coal consumption is most likely to remain in slow but steady decline, said Xu Zhaoyuan, considering that a rebound in investment in energy-intensive industries would be unexpected in the current economic climate.

This is due to the investment-led economic development model reaching a deadlock, where infrastructure construction is no longer seen as profitable as it once was, noted Liu Qiang.

Both experts believe that China's economy will see even slower growth as the transformation continues, with traditional industry struggling to survive while drivers of sustainable new growth gradually emerge.

Many industrial enterprises will find it hard to wean themselves off cheap coal, but China's diminishing tolerance for pollution makes it impossible for coal to regain significant ground, noted Xu.

The Beijing-Tianjin-Hebei region and the Pearl River Delta region, both prioritised as part of the agenda to reduce air pollution treatment, have been told by central government to burn less coal in 2017.

Good news for climate

The new data bodes well for the climate. A Greenpeace analysis indicates that 2016 could be the fourth year in a row when China sees either zero growth or a decline in CO2 emissions. Lauri Myllyvirta, senior coal campaigner for Greenpeace East Asia, told the Associated Press that China's levelling carbon emissions have completely revolutionised the prospects for bringing global emissions and climate change under control.

Lin Boqiang, dean of the China Institute for Energy Policy Studies at Xiamen University told *chinadialogue* that "the decrease in China's coal consumption in 2016 was a result of a change in economic structure and an increase in clean energy. In any case, China's energy system will continue to decarbonise and the share of coal in China's energy mix will shrink further."

Feng Hao is a researcher at chinadialogue.

Tang Damin is Beijing senior editor of chinadialogue.

中国煤电加速降温

从2016年开始愈演愈烈的煤电项目叫停风潮显示，新的一年里，中国煤电行业将面对更加狭小的生存空间。

□ 冯 灏

东北省区之一宁夏的一个煤矿。为了应对中国煤炭行业的产能过剩，该地区许多煤矿正在关闭

如果说刚刚过去的2016年被一些中国媒体称为“煤炭叫停年”，那么新年的第一波煤电政策似乎显示，2017年将会是2016年的升级版。

新年刚刚到来两周，煤电行业就迎来了本年度的第一个重大打击。1月13日起，多份《关于衔接省“十三五”煤电投产规模的函》在业内流传。至少11个省或自治区收到国家能源局电力司发往省一级发展改革委员会的函件，其内容大同小异：这些地区被要求压减“十三五”期间（2016-2020年）的煤电投产规模，没有达到“核准建设条件”的一律推迟到“十四五”（2021-2025年）及以后。

目前收到相关函件的省（区）包括青海、陕西等西北六省，其余五省位于中部和南部。据中国电力行业资讯网站bjx.com.cn报道，西南的四川和东北的辽宁两省也接到了同样的命令。

据财新网核算，这批禁令叫停的新建、在建煤电项目达到至少101个，总装机超过1亿千瓦，涉及

的总投资额在4300亿元左右。

此前，国家能源局已经于2016年9月宣布“取消一批不具备核准建设条件煤电项目”。位于吉林、山西、山东等九个省(区）的15个煤电项目被取消，装机总量1240万千瓦。

不到四个月的时间里，中国取消的煤电项目装机量超过了五个三峡水电站。每日经济新闻援引不具名的能源局电力司官员称，1月的这一批叫停措施将让目前中国各地规划中的煤电装机总量直接减半。

“不到四个月的时间里，中国取消的煤电项目装机量超过了五个三峡水电站。今年1月的叫停措施将让目前中国各地规划中的煤电装机总量直接减半。”

煤电风险警报响起

那么，一个煤电项目要想在2020年开工建设，要怎样才能达到国家的“核准建设条件”？按照2016年4月国家能源局出台的各省煤电规划建设前景的风险预警机制，处于煤电装机已经过剩地区的项目已经基本没有机会获批。

这个机制将中国的省级电网按照三个指标分级：首先是经济性，即投资煤电项目的收益率；其次是煤电装机充裕度，可由发电设备的闲置时间体现；最后是资源约束指标，包括煤炭和水资源的充裕程度和空气污染程度。

2019年煤电规划建设风险预警结果显示，33个省级电网区域(包括蒙东、蒙西和冀北、冀南）中的28个区域为预警程度最严峻的“红色”，在这些省区规划新的煤电项目被认为是不明智的，地方政府要暂缓核准。

这一预警机制来自国家发改委和能源局此前于2016年3月联合下发的特急文件。该文件还明确表示：对于电力盈余的省份，原则上不再安排新增煤电项目。共有13个省(区）被能源局认定为电力盈余，被要求暂缓批准新建煤电项目，15个省(区）的已获批项目被禁止开工。

在全国政策方面，2016年11月7日，《电力发展“十三五”规划（2016-2020年）》正式对外公布，在电力结构方面设定的指标是将煤电在全国电力总装机中的比例由2015年的59%下降到2020年的55%，总装机不得超过11亿千瓦。国家能源局总工程师韩水还表示，“十三五”期间（2016年-2020年）将取消、推迟煤电建设项目至少1.5亿千瓦。

全行业亏损的风险

然而，时间刚到2017年的第一个月，全国被叫停的煤电装机就已经超过1.1亿千瓦，这意味着煤电行业面临的产能过剩可能比预想的要严重得多。

能源局2017年1月公布全社会用电量等数据，其中2016年火电设备平均利用小时为4165小时，继上年再次下降，同比减少199小时。

发电设备平均利用小时数是发电厂发电设备利用程度的指标。按照电力行业的一般规则，如果某一地区的全年设备利用小时数高于5500小时，表明该地区用电紧张，可继续增加电源投资。如果低于4500小时，则表明该地区电力富余，一般不能再新增发电装机。以5500小时的火电盈亏平衡点测算，过剩程度已近1/4。

国家能源局局长努尔·白克力此前表示，近年来煤电装机规模快速增加，煤电产能过剩潜在风险逐步显现。“如果按这样的发展态势，未来几年，我国煤电行业将会变成现在的钢铁和煤炭行业。”

对于2017年，这位中国能源政策掌门人更是直言：煤电的增长空间只会更小，面临全行业亏损风险。

冯灏，中外对话研究员

2017 set to be a bleak year for coal

China cancelled many power projects in 2016 but the sector looks set to get squeezed further this year

□ Feng Hao

Last year was the "year of cancelling coal" declared some Chinese media outlets, but the latest coal power policies suggest that 2017 is going to be even worse for the sector.

The first blow landed less than two weeks into the New Year, when on January 13 a government letter started to circulate among industry insiders about plans for coal power expansion across the provinces.

The letter was issued from the National Energy Administration's (NEA) Electricity Department to the development and reform authorities of at least eleven provinces and autonomous regions.

The letter said that in accordance with the 13th Five-Year Plan (2016-2020) coal power capacity must be reduced and projects awaiting approval would be pushed back to 2021-2025 for review.

Six large provinces in the north-west received the letter, including Qinghai and Shaanxi, with the other five in central and southern China. According to one coal industry website similar letters were received in Sichuan in the south-west and Liaoning in the north-east.

Energy reform

In November 2016, the government published its national level programme for developing the electricity sector in the 13th Five-Year Plan (FYP). It set a target for reducing the proportion of coal-fired power in the overall energy mix to 55% by 2020, down from 59% in 2015.

To help achieve this, it placed a cap on coal power capacity of 1,100 gigawatts. At the time, Han Shui, the NEA's chief engineer, announced that 150 gigawatts of capacity would be cancelled or postponed during the period up to 2021 to this support this effort.

News platform Caixin.com calculated that the latest order will affect 101 projects that are already in planning and building stages and that amount to investment of about 430 billion yuan (US$62.5 billion) and a total capacity of 100 gigawatts.

The latest order follows an announcement in September 2016 by the NEA cancelling 15 projects, totalling 12.4 gigawatts, which were still awaiting construction approval across nine provinces, including Jilin, Shanxi and Shandong.

In less than four months China has cancelled coal projects with the generation power equivalent to five Three Gorges Dams. An unnamed official with the NEA's Electricity Department was quoted in the New Business Daily saying that the cancellations have halved planned coal power construction in the country.

Coal overcapacity

The outlook for new coal construction from 2020 looks similarly bleak. Under the NEA's early warning system, designed to flag up financially risky coal investments, it is almost impossible to get approval in a province where there

Fig. 1 Surplus coal capacity by province

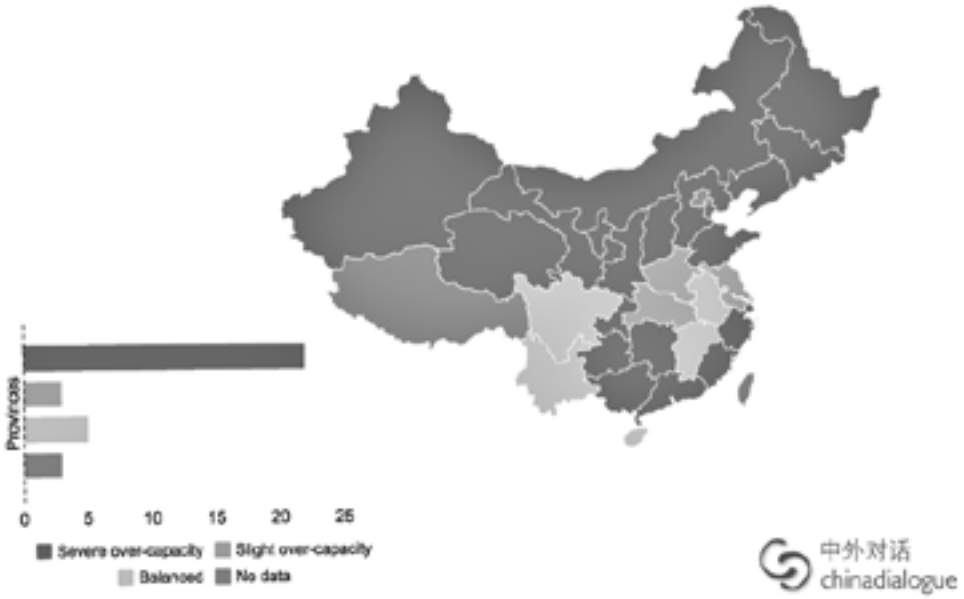


Fig. 2 Provinces with environmental constraints

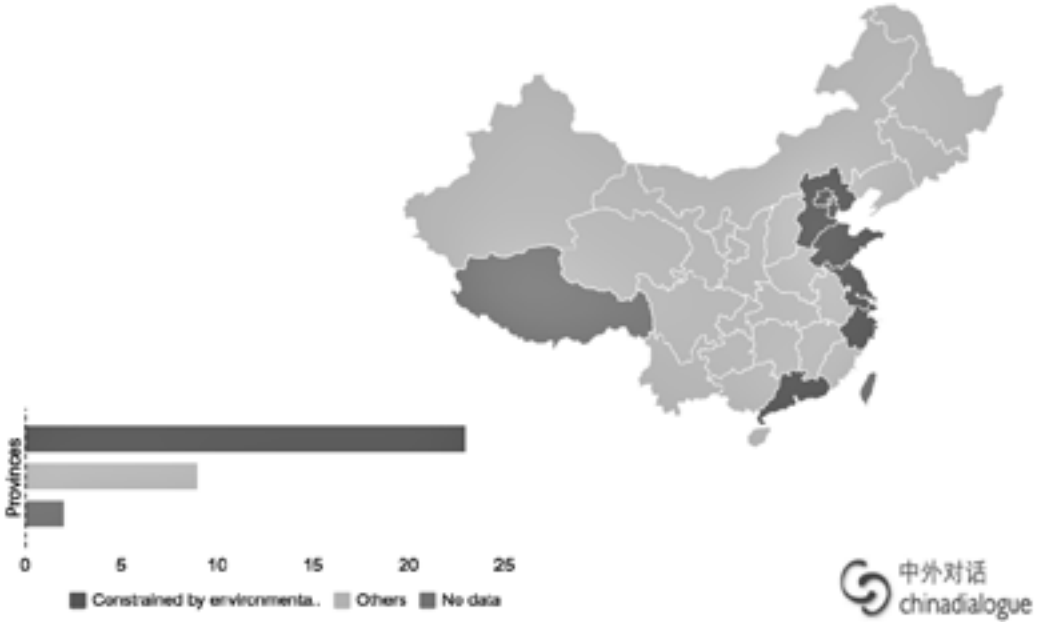
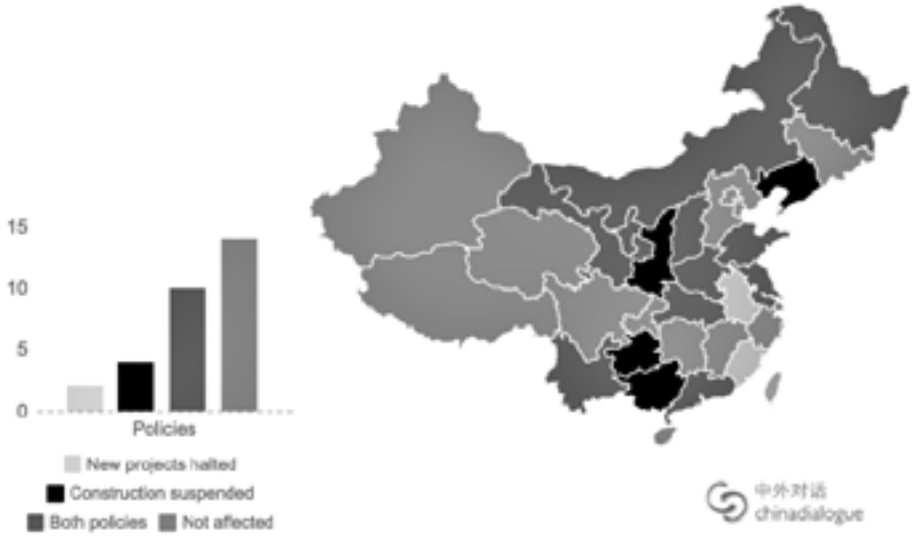


Fig. 3 NEA's coal shutdown policies



is already a surplus of coal-fired power.

That system classifies provincial power grids based on three criteria: profitability of coal power; the rate of utilisation of existing capacity; and resource constraints (availability of coal and water, and the degree of air pollution).

In 2016, 28 of 33 provincial level power grids were given the highest red warning, triggering local governments to delay the approval of new coal-fired generation.

The warning system itself arose out of an urgent notice issued by the NEA and the National Development and Reform Commission in March 2016, which stated that provinces with electricity surpluses should not, in principle, allow any new coal power construction.

Thirteen provinces were identified as having electricity surpluses (see Fig. 1) and were ordered to halt new approvals, while a further fifteen were ordered to halt construction of projects that had already been approved.

Danger of industry-wide unprofitability

The new measures taken in January bring the total cancelled or delayed coal capacity to 1,100 gigawatts. This suggests that the risk of overcapacity was even graver than initially expected.

NEA data on China's overall electricity consumption published this month shows that coal-fired power plants operated for an average of 4,165 hours in 2016, a fall of 199 hours year-on-year and a sign that the trend for electricity consumption to decline continues.

The number of annual hours of operation is a good indicator of how much power plants are being utilised. Within the coal power industry it is generally held that a figure of more than 5,500 hours means a region is short of electricity and more investment is possible.

If the figure falls below 4,500 hours there is a surplus and new capacity should not be built. If 5,500 hours is the threshold at which coal-fired power becomes investable, then China's current coal capacity is already 25% too high.

Nur Bekri, head of the NEA, has said that the rapid increase in coal-fired power construction in recent years has made the risk of over-capacity more apparent.

"If development continues in this way in the coming years, the coal-fired power sector will end up in the same situation as the coal mining and steel sectors today," said Nur.

Nur was blunt about the outlook for 2017: the scope for expansion is only going to narrow, and there's a risk of industry-wide unprofitability.

Feng Hao is a researcher at chinadialogue.

煤炭“僵尸企业”的寒冬来了

2017年中国煤炭行业去产能重点将出现调整，要重点去除效率低、技术差的产能，重点处置“僵尸产能”，同时更多地让市场决定煤炭产量。

□ 冯 灏

国务院发展研究中心产业经济研究部研究室主任、研究员许召元在接受中外对话专访时说，与2016年大规模、普遍性的去产能不同，2017年煤炭行业的去产能将着重在低效率的僵尸企业上。政府希望减少短期强制性行政手段的使用，让市场调节在产业转型中发挥更大的作用。

中外对话（以下简称“中”）：国际能源署最近发布的报告预测全球煤炭需求会有结构性下降，但速度会很慢，而且强调最大的变数来自中国。您对中国煤炭市场的需求形势作何判断？

许召元（以下简称“许”）：国际国内的研究机构多数都预测煤炭的需求在今后一段时期会处在平台期，不会出现短期内突然的大幅度下降。

需要留意的一点是，煤炭需求、包括能源的总需求其实和电力需求是密切相关的。虽然一些重化工业，像水泥、钢铁可能到达需求顶峰，但是还有很大的一块是居民用电，这一部分随着生活水平的提升、电气化的进一步增强、生活舒适度的增加，在相当长的时期内还是会持续增长。

所以，综合生产用电、生活消费用电，电力需求还是呈缓慢增长的趋势，其中煤电占很大比例。短期内，无论是风电、光电，还是水电、核电都不足以完全替代，所以电力这一块还会体现出对于煤炭的需求。

中：过去的2016年，煤炭行业的价格波动非常大。以炼焦煤为例，5月份以来炼焦煤的现货价格不断上升，10月份已经打破了每吨300美元的水平。价格的大幅度波动是否反映出煤炭市场的供需形势有了逆转的变化？

许：煤炭钢铁价格的短期波动，还不能认为总的供需形势有了逆转的变化。事实上从稍长一段时期内，钢铁、煤炭的产能过剩将持续存在，供不应求只是短期或局部地区的现象。煤炭的需求有个特点，经济学上称之为“低价格弹性”，就是说价格的变化在短期内对需求量的影响很小，而多数产品价格变化对需求量影响是比较大的。比如一种品牌的汽车价格上涨10%，有不少消费者可能就转到其他品牌了。而煤炭价格提升甚至大幅度提升时，短期内企业很难用其他能源来代替，也就是说短期的供需不平衡可能会造成很大的价格波动。我们不能简单由煤炭价格的短期变化就对供求形势做出逆转的整体判断。

中：经济性的考虑之外，煤电利用的环境和社会成本是不是也应该列入考量？

许：煤炭和其他能源的生产和消费使用中，都会产生环境和社会成本，目前这部分成本在能源价格体系中还没有得到充分的考虑，我们认为应该通过税收的形式，让各

内蒙古蒙发煤炭公司的卡车和拖拉机在乌兰木伦卸煤

种能源的环境和社会成本都能够有正确的体系，这样有利于选择最合适的能源结构。

具体到对于煤炭的利用而言，我们的建议是可以适当发展用于集中供电。因为现在煤炭消费还有很大一部分用于非发电领域，而散煤燃烧的污染一般说来数倍甚至于数十倍大于煤电，因此在目前清洁能源总量有限、价格较高的情况下，应该把天然气等能源更多的用于替代散煤，短时期内可以允许煤电一定比重的提高。这样虽然看起来煤电的消费在扩张，但是如果把散煤燃烧更大幅度的减下来，对于整体污染的改善是有好处的。

中：煤电利用的碳排放也不容忽视，那中国将如何履行减碳的国际承诺呢？

许：实现减碳的目标，不能直接通过煤炭行业行政手段去产能这样的方法，因为只要经济中有需求，硬性地减小供应不能解决问题。就如前些年，一直在限制钢铁企业投资，采取了很多很多办法，但经济发展对钢铁有需求，产能还是上去了。对于碳排放，根本还在于发展清洁能源、调整能源结构、促进散煤替代等多方面的措施。短期内政府强力行政手段的介入是为了行业的脱困发展，不能为了去产能而去产能。

绿色、清洁是一个大的方向，公众非常关心怎样提高企业绿色生产的水平、减少碳排放。在这一方面，环境标准的执行就显得非常重要，环境税的征收也释放出非常明确的政策信号。

另外，市场化机制真正发挥作用，一定要做到企业分化，即要让合规排放、效率更高的企业效益好，低效率、不守法的企业效益差。

中：具体到去产能的方式，2016年政府是在什么背景下做出了全国煤矿276个工作日的行政规定？

许：在2015年底2016年初煤炭价格持续下降的情况下，市场机制没有发挥有效的作用，存在失灵现象。因为按理说煤炭价格下降，企业产出煤炭是亏损的，理性选择应该是减少产量以减少亏损，但是有不少企业越是价格低越增加产量，以维持企业的现金流。煤炭价格在下降，部分企业还在增产，使得行业陷入恶性循环。在这样的背景下，中央政府采取了去除过剩产能的强力手段，政府行政性手段起到托底的作用，摆脱恶性循环。

煤炭行业的一个特点是一些大企业，特别是国有企业，用工较多，而且地方产业结构单一，如果大企业出现经营风险，会涉及相当数量煤炭职工的生计。在很多地方，一个小城、一个小镇就是依靠一家煤炭企业在支撑。这家煤炭企业破产了，整个地方的经济会受到很大的冲击，面临社会风险。

2016 年初，煤炭行业多数企业面临亏损，尤其是人数比较多的国有企业，比如一些煤炭集团几个月发不出工资，不少企业面临债务危机，甚至生存风险，政府意识到煤炭行业已经成为宏观经济中的重要风险点，因此果断采取了去产能的有力措施。

中：随着煤炭市场的变化，中国下一步去产能的目标和政策会有什么调整吗？

许：2016 年后，煤炭价格回到了目前的水平上，多数企业实现了盈利，行业整体经营形势有所好转。

2017 年“去产能”这个大的方向不会变，但是政策根本目的是为了促进行业的脱困，让其有序健康的发展，而不是说一定要把产能产量控制到一个特定的水平。市场的需求本身是波动性的，政府也没有办法很准确地预测需求就是多少，过于硬性的去产能目标与实际总会有一定差异。

展望 2017 年，中央经济工作会议上提出要抓住去除“僵尸企业”的牛鼻子，也就是要把注意力转移到比较差的产能，比如生产效率低、技术水平差、安全质量不达标的企业。对于整个产能产量，政府应该放松管理，给市场调节更大的空间。

中：市场发挥作用的前提是价格信号有意义，低效企业会削减产量或者破产倒闭，自动退出市场，但 2016 年的现实是这些企业依靠银行和地方政府输血，背负巨额银行债务却“大而不能倒”。那么，市场机制该如何发挥作用呢？

许：首先，企业的有效退出是煤炭市场能够发挥市场调节作用的前提，而社会保障的安全网是企业有效退出的前提。该政府承担的责任应该由政府来承担，比如地方政府工作的重点应该在更好的社会保障、就业体系，不应该让国有企业承担不属于它的社会责任。只有建立起社会安全网，在市场价格调整的时候，那些不具备市场生命力的企业才可以关闭，僵尸企业才可以处置。

第二，要通过法制塑造公平的竞争环境。现在针对煤炭生产的安全、质量、排放等都有严格的标准，但仍有一些煤炭企业逃避生态保护和后期恢复的成本，反而在竞争中获得了不公平的优势。在这一方面，应该通过跨区域之间的检查，让各种企业承担其应付的责任和成本，促进煤炭企业的分化。

第三，煤炭的价格应该调整到他本来应该的水平，这个价格不是通过行政手段调节供需所反映出的价格，而是充分体现煤炭生产外部成本的价格。

冯灏，中外对话研究员

The end is near for China's "zombie" coal mines

China is planning to reduce coal capacity by closing idle mines and giving markets a greater role, says Xu Zhaoyuan

□ Feng Hao

Xu Zhaoyuan is a senior figure at the industrial economy department in China's State Council Development Research Centre, an agency responsible for policy research. In an interview with *chinadialogue* he said that the agency's focus is shifting from the reduction in coal output in 2016 to closing inefficient "zombie" mines in 2017, which are often propped up by local government funding. In this next phase, ensuring there is adequate support for workers who stand to lose their jobs will be essential. The government also hopes to reduce its reliance on interventionist measures, such as removing surplus capacity, to control coal output and let the market play a greater role in the sector's transition.

chinadialogue (CD): The latest report from the International Energy Agency predicts a structural decline in demand for coal globally, but claims this will be very slow. It stressed that the biggest change will come from China. What are the key coal market trends in China?

Xu Zhaoyuan (XZY): Most Chinese and domestic research bodies expect coal demand to plateau for some time, with no sudden drop in the near future.

But we need to remember that coal demand, and also total energy demand, is closely linked to demand for electricity. Although we may have seen demand from some heavy industries such as concrete and steel-makers reach a peak, domestic customers still make up a large part of electricity demand. And that will increase as we see living standards rise and more electrification. There will be growth for some time to come.

Demand for electricity, including for industry and domestic use, will see slow growth, and coal-fired power will provide the vast majority of that. Coal can't be replaced in the near future, not by wind or solar, nor hydropower or nuclear. So we'll still see demand for coal power generation.

CD: 2016 saw huge changes in the price of coal. For example, coking coal has been increasing in price since April 2016, breaking the US$300 (2,050 yuan) / tonne

mark in October. Doesn't that show a reversal in supply and demand trends?

XZY: Short term fluctuations in coal and steel prices don't mean there's been a turnaround in supply and demand trends. Overcapacity in coal and steel is actually going to continue for quite some time and supply shortages will be only temporary and local. One feature of coal demand is what economists call "low elasticity" – price changes do not in the short term affect demand, unlike most other products where prices have a greater impact on demand. For example, if one brand of car becomes 10% more expensive, consumers can buy another type. But if coal goes up in price, even significantly, companies can't just quickly switch to another source of energy, and that means that short term supply shortages can result in large price fluctuations. We can't look at short term changes in the coal price and deduce that supply and demand trends have reversed.

CD: Should energy prices account for the environmental and social cost of producing coal?

XZY: The production and use of coal, and other sources of energy, involves environmental and social costs, and currently these aren't fully reflected in energy prices. We think those costs should be included, in the form of taxes, and this will help guide the selection of the most suitable energy mix.

When it comes to the use of coal, our suggestion is that it is used appropriately for large-scale power generation. Much of coal consumption is currently used for other purposes, for small-scale coal-burning which creates several times as much pollution. So currently, while sources of clean energy remain limited and more expensive, sources such as natural gas should be used to replace small-scale coal burning and allow for a certain expansion of coal-fired power in the short term. So although it would seem coal use for power generation is increasing, a large decrease in more polluting uses of coal use means that overall pollution is lessened.

CD: The carbon emissions from coal-fired power can't be overlooked. How will China fulfil its international emissions commitments?

XZY: We can't achieve those targets through government-ordered removal of capacity, as long as there's demand from the economy an enforced reduction in supply won't work. For example, many different approaches have been taken to reduce investment in steel recently but economic growth means there is demand and capacity has continued to increase. The key to reducing carbon emissions is to take a range of measures: development of clean energy, adjustments to the energy structure, replacement of coal with other sources of energy in small-scale uses. In the near term the government will intervene to help the sector through a difficult period, but we can't just remove capacity for the sake of it.

In general there's an overall move to cleaner energy and the public is keen to see greener companies and reduced pollution. The enforcement of environmental standards is very important here, and the environmental tax is sending a very clear policy signal.

Also, market mechanisms should be used to differentiate between companies. Those which meet emissions standards and are efficient should be more profitable than those which are inefficient and break the law.

CD: When we look at specific measures to reduce coal

> "Firms which are not competitive will only close down if there is a welfare safety net, otherwise they become "zombie" firms."

output, what drove the governement to limit coal mines to 276 days of operation in 2016?

XZY: There were sustained falls in the price of coal in late 2015 and early 2016, but market mechanisms were failing. In theory, if the price of coal drops coal mines lose money, and output should be reduced to cut those losses. But many companies actually boosted production to maintain cash flows. The combination of falling prices and increasing output sent the industry into a downward spiral. Therefore the government enforced the shutdown of surplus capacity, which stabilised the market and stopped that spiral.

The nature of the coal industry means that some big firms, particularly state-owned enterprises (SOEs), are labour intensive and dominate the local economy. If those companies are at risk the livelihoods of many miners are threatened. In many places an entire city or town may rely on one coal firm. That firm going bust can do huge damage to the entire local economy and create social problems.

In early 2016 most coal firms were suffering losses, particularly the SOEs, which have larger work forces. Some coal firms hadn't been able to pay wages for months, many were facing debt crises or even closure. The government saw that the coal sector was a risk to the entire economy and took decisive action, removing surplus capacity.

CD: As the coal market changes, how will the government tackle capacity reduction in the future?

XZY: Coal prices have recovered and most companies are profitable again, so there's been an overall improvement in how the sector is working.

The year ahead won't see any change in overall efforts to reduce capacity. But the core aim of the policy isn't just to reduce output to a particular level, it's to steer the sector through a difficult time and return it to healthy growth. Market demand naturally fluctuates, and the government has no way to predict what demand will be, so output targets and actual demand will never match up exactly.

Looking forward to 2017, it was proposed at the Central Economic Work Conference that "zombie companies" – companies which are inefficient, have poor technology, and or don't meet safety standards – be removed. The government should step back and give the market more room to regulate output.

CD: For the market to play its role price signals have to be meaningful. This means that inefficient firms must be allowed to reduce their output or go bust. However, in 2016 these firms received cash injections from the banks and the local government, leading them to acquire so much debt that they became "too big to fail." So how can market mechanisms come into play?

XZY: First, the removal of inefficient firms is essential if the market is going to play an effective role, but a welfare safety net for unemployed workers is also needed. The government should bear the burden. For example, local government should be focused on creating better welfare and reemployment, rather than having SOEs take on extra responsibilities. Firms which are not competitive will only close down if there is a welfare safety net, otherwise they become "zombie" firms.

Second, legislation should be used to level the playing field. There are strict safety, quality and emissions rules for coal mining, but some companies still manage to get out of paying for environmental protection and restoration, which gives them an unfair advantage. We should have cross-regional inspections to ensure firms take on the appropriate responsibilities and costs, which will allow the best of them to flourish.

Third, coal should be price properly; and not based on government adjustments to supply and demand, but on a price that reflects the external costs of coal.

Feng Hao is a researcher at chinadialogue.

被挖空的城市：煤炭的真实成本①

斯塔姆·李探访遍布中国的采煤沉陷区，镜头下的满目疮痍揭示中国社会为煤炭所付出的真实代价。

□ 斯塔姆·李

在中国，有很多城市以煤而兴，又因煤而衰。它们凭借煤炭资源生长壮大。一朝资源耗尽，便有了个名字——资源枯竭型城市。轰鸣静止，机械锈蚀，尘埃落定，大自然开始反噬。

这些地方有一些相同关键词：能源、经济引擎、污染、采空带、沉陷区……也忍受着类似的后遗症：陷坑密布，房倒屋塌，河流干涸……

中国经济40年的快速经济发展带动了巨量能源资源需求，作为中国能源资源主要分布地：山西、陕西、内蒙古三个区位枨比相邻。20世纪初，煤炭行业进入蓬勃发展的“黄金时代”，暴利的行业利润如魔法般吸引各类资本涌入，甚至是房地产、装备制造、烟草等毫不搭边的企业都跃跃欲试。在黄金十年期间，身处“黑金”中的村民，投身小煤窑，承包土地、集资建矿，比比皆是。在这一带，煤炭被叫做“黑金”，煤矿被称为“金山”。它们搭乘煤炭能源经济发展这辆马车一路高昂，踏着得天独厚能源丰沃的土壤飙歌猛进，曾创造一个个关于财富的神话。

湖北黄石，小矿被关停后，有的矿井的矿口，都没来得及封闭

但成也煤炭，败也煤炭，煤炭产业的繁荣隐含着巨大的代价。伴随着煤炭开采、运输和使用而来的环境破坏和人的生命折损在很多地方都达到触目惊心的地步。然而，这些代价却因为各种原因没有被计入煤炭的真实成本当中。

2014年，清华大学和环保部环境规划院等单位进行的研究表明，煤炭全生命周期的水资源损耗、人体健康影响和生态系统退化等外部成本高达260元每吨，而现有的税

2016年，山西大同矿区

沉陷区的居民越来越少，矿区的一个葬礼，也没几个人参加

山西大同矿区，由于采煤，当地水源改道，大量河流干涸

费完全无法涵盖这些成本，变成全社会为煤炭的高昂成本买单。

这份研究尤其指出，煤炭开采产生严重的地表塌陷，是亟待解决的地质环境问题。目前中国每万吨煤炭生产导致的地表塌陷就多大2700平方米，每年约800平方公里土地遭到破坏。

中国大大小小的煤矿沉陷区，成为抽象的“煤炭真实成本”留在大地上的最具象的伤疤。安徽淮南矿区因地面塌陷，整片村庄沦为湖中的历史遗迹；山西大同矿区因采煤导致河流改道，大量河道干涸；湖南冷水江矿区，由于采矿沉陷，出现大量危房，居民不得不举家外出躲避…

受国内外宏观经济增速放缓、节能减排要求提高、能源结构优化等诸多因素影响，主要用煤行业耗煤减少，使得煤炭需求减少，产能过剩问题突出。2012年下半年，煤炭行业开始走下坡路。

始于2002年的中国煤炭行业“黄金十年”，让国有煤企迅速壮大。10年后，当这些大型煤企陷入巨亏泥潭，昔日被高速发展所掩盖的整个行业的问题更为集中地暴露出来。

“挖煤卖资源，挖石烧水泥”的资源型、粗放型经济增长方式，使这些资源型城市在经济蓬勃发展时，辉煌而不可一世。然而，随着煤炭资源枯竭、涉煤产业低迷，所有问题仿佛几场暴雨后，被成片淹掉的村庄一样，短时间暴发出来。大面积的地面塌陷，生态环境退化，各种基础设施，居民区和耕地不同程度的遭到破坏，严重威胁到整个城市生态环境的可持续发展。

采煤沉陷区日益成为地方经济的“累赘”，也成了永远无法弥补的历史坏账——占用了大量耕地和农田。

采煤塌陷区生态环境退化是全国煤炭资源城市的共性问题，也是中国以煤为主的能源结构所带来的真实代价。直面“煤炭的真实成本”，是讨论和实践中国能源革命和经济转型的出发点。

斯塔姆·李，自由摄影师

Mined-out cities: the true cost of coal

Stam Lee has travelled China photographing mining areas,
his images of scarred landscapes reveal the environmental debt left by China's coal boom

□ Stam Lee

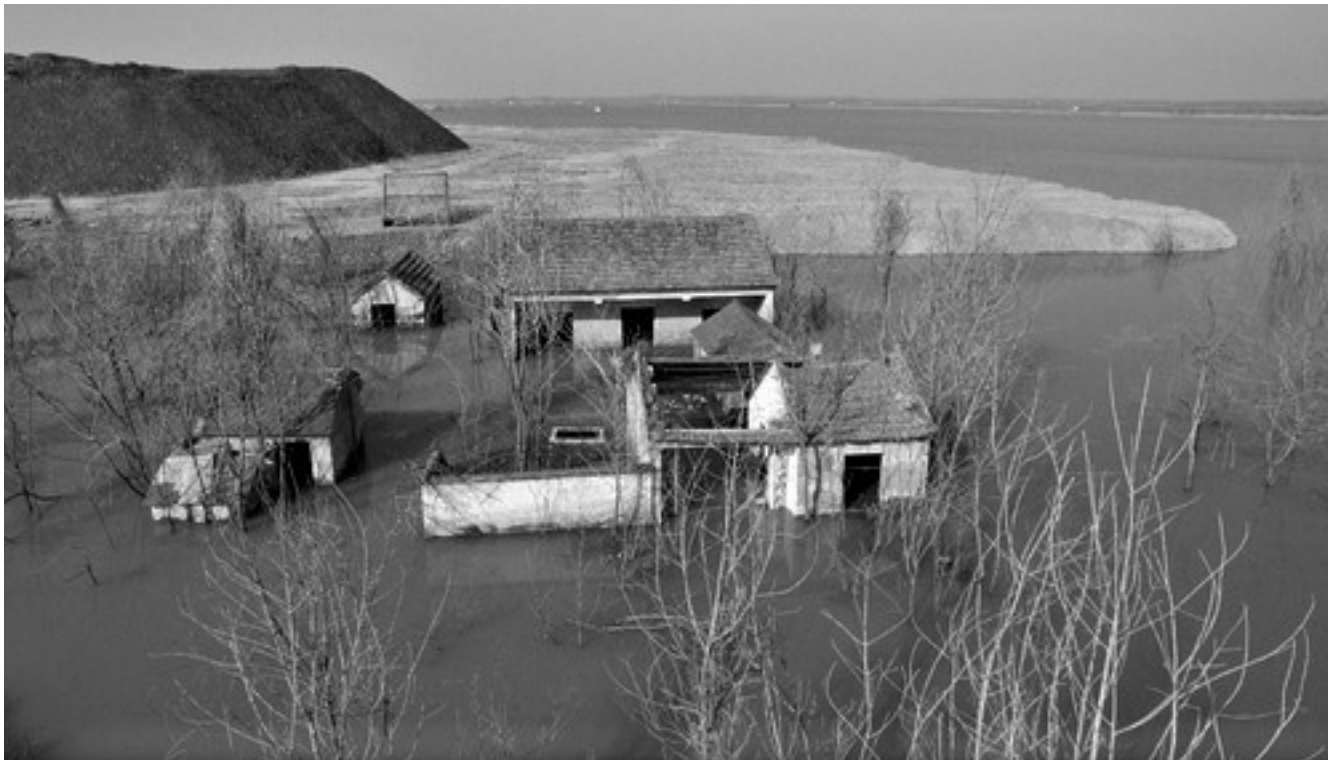
The mines are expanding, getting ever closer to the village graveyard

Many Chinese cities were founded on coal but are now being ruined by it. Forty years of rapid economic growth in China has driven a huge demand for energy that has transformed the landscape of coal-rich provinces in the south-east and north of the country. But as coal mines have become depleted or shut down as a result of slowing industrial growth, cities that once thrived on coal have suffered the most as they are forced to deal with a legacy of subsidence, lost agricultural land and dried-up rivers.

The boom years

The start of the 21st century was a golden era for the coal sector. Rapid expansion of state-owned coal firms led to huge

Mining area in Huangshi Hubei 2016



A coal pile in Huainan Anhui, next to villages being submerged

In 2007,Ouyang Shican used his life saving to build a modern home of several hundred square meters for his family. Soon after they moved in the foundations started to subside and walls cracked, a deep hole appeared

profits, which attracted many kinds of investors, even from unrelated fields such as property, machinery and tobacco.

During the boom decade, rural residents in coal rich areas dug small mines, leased land and borrowed money to fund larger operations. Coal is known as "black gold" and a mine is a "mountain of gold". Local economies hitched their carts to the coal boom and got rich from the energy buried beneath the ground.

But ten years later the huge firms are suffering losses, and the true costs of coal that were hidden by the boom are now increasingly apparent in environmental destruction and serious harm to human health from mining, transportation and coal use. These costs are not included in the price of coal.

The damage done

Research carried out by Tsinghua University and the Ministry of Environmental Protection's Chinese Academy of Environmental Planning in 2014, found that external costs incurred throughout the coal lifecycle – use of water resources, impacts on health, and damage to the environment – totalled 260 yuan per tonne, nowhere near the taxes and fees on coal production and usage. It is society as a whole that pays these additional costs.

The study also found that coal mining causes serious surface subsidence. Currently 2,700 square metres of land subsides for every 10,000 tonnes of coal mined, with 800 square kilometres of land damaged every year.

Widespread subsidence in mining areas is the literal scar of the coal boom, a historical debt that cannot be repaid. This photo series commissioned by *chinadialogue* shows the environmental degradation and harm to infrastructure, homes and agriculture faced by communities in Anhui, Shanxi, Hubei, Hennan, Jiangxi, Yunnan and Gangsu. In these former mining areas entire villages have been lost, submerged by lakes or emptied out of people forced to flee their homes because they can no longer trust the ground beneath their feet.

Stam Lee is a freelancer photographer.

被挖空的城市：煤炭的真实成本②

江西萍乡巨源村见证了煤炭产业兴衰。煤矿衰落之后，留给当地村民的是垮塌的房屋、污染的水源和无奈的未来。

□ 斯塔姆·李

早在2004年，江西省萍乡市就启动了煤矿沉陷区移民工程。巨源村虽然已被划入沉陷区，可十多年过去，仍有部分村民至今未能搬离，他们在痛恨、恐惧和犹豫中坚守。煤矿都停了，煤老板也走了，房屋在塌陷，他们在挣扎。无奈中，1个老头和6个老太就盯上了来拉残煤的司机，他们一次次在破碎山间和崎岖的黑色小路上飞奔，“讨”点生活。

开始，我以为他们是偷煤的。一个老头带着6个老太太向坡下的三岔路口狂奔，那气势就象是听到发令枪响后的百米冲刺。只是老头老太们的步态让人觉得有些滑稽。其中1个才奔出10多米，就掉队了。等他们到了路口，我才看清楚状况。他们是远远听到卡车的轰鸣声，所以冲到必经的三岔口去拦车。拦车做什么呢？讨钱！

讨多少？10块！如果没有话，7块、8块……也行！来往的司机们也似乎与他们保持有默契，没惊愕，没有讨价还价，更没有争吵。

江西安源煤矿深陷区，1个老头和6个老太就盯上了来拉残煤的司机，他们一次次在破碎山间和崎岖的黑色小路上飞奔，“讨”点生活

我在煤坡顶看了一下午。有的“有经验”的司机，会在三岔口处加大油门，还没等拦车者冲到山下，车就已经过去了……傍晚6点“收工”，7个人，共收到21元8角，除去零头，每人分到3元整。

村庄里，人很少，偶见几个老人和孩子，一有陌生人，狗就狂吠不止。有拉煤车或中巴客车经过时，便会扬起黑蒙蒙的一片灰尘，那是煤灰。路人急忙捂住口鼻躲闪。

阿四站在一座废弃的矿井排风口，斜倚着抽烟。他觉得很无奈。阿四的家是个砖混小楼，紧贴着采矿坑，停采后，矿坑已经变成了小湖。

有个老太太，带我去村里看房子。危楼紧贴着后面的采矿坑，由于矿区已停采，矿坑形成了一个湖。房

一间房屋里还留着一对新婚夫妇的婚纱照，可以想象，他们撤走得多么匆忙

子满是裂缝，最宽的地方可以塞进成人的三根手指。地面水泥也已经松动，有些地方拱起一个小坡。

这里是江西省萍乡湘东镇巨源村。也是当地大型煤矿——巨源煤矿所在地。萍乡素有“江南煤都”之称。新中国成立后，这里更是因煤而兴，兴办的煤矿高峰期达1000多家。然而，如今，一百多年的开采让萍乡在面临煤炭资源枯竭的同时，也给当地村民带来了突出的沉陷问题。

巨源煤矿作为萍乡矿业集团下属煤矿，属于国家统配煤矿开采，按照当时的政策，全村都应被划入沉陷区，不少村小组相继整体搬离当地，被统一安置在湘东区一个叫五里亭的地方。

萍乡人不得不开始另谋出路。一片片“工人村”变空了，变成了另一种鬼城。巨源村并没有整体搬迁，当地村干部说，一方面当时整体搬迁资金有限，另一方面部分房屋并不位于沉陷区的核心地带，因此才将整体搬迁搁置了下来，取而代之的是优先搬迁安置房屋沉陷严重的村民，其他村民只能一次性领取1000-2000元的房屋维修款，等待来年的再次鉴定。然而，他们一等便是十多年，再没收到任何房屋维修款。

除了房屋开裂沉陷，环境污染也如影随形。村里房屋的外墙上，可以看到许多这样的宣传标语:“防氟改灶，人民受益。”煤矿带来氟污染，饮水和空气中过量的氟引起氟中毒，造成了氟斑牙和氟骨病。村里常见村民豁牙、拄拐，都与氟污染脱不了关系。

等待搬迁的村民家中，墙上裂开巨大的缝隙。不少村民家中的裂缝越来越大，门窗也无法开关，他们常常因害怕整夜失眠。

由于长期开采，矿区发生沉陷，地表水透入地下矿洞中。矿区村民的生活生产一度无水可用，只能靠喝下雨时山上流下来的黄泥水。村民们说，在多次反映后，最终他们用上了矿上的地下水，但矿上的地下水含钙量高，他们担心长期饮用不健康，因此，还是只能到3公里之外去挑水，要么去十多公里外的镇上购买桶装水。村民们吃喝住行，已经全面被采煤后遗症包围。

斯塔姆·李，自由摄影师

Mined-out cities: the social cost of coal

Stam Lee's photographs of Juyuan in Jiangxi show coal mining's harsh legacy: a struggling population, damaged houses, polluted water and little hope

□ Stam Lee

The Jiangxi city of Pingxiang in southeast China started relocating residents affected by subsidence caused by coal mining as early as 2004. The village of Juyuan lies within the affected area, but more than ten years later some of the villagers are still waiting. The mines are closed, the owners gone, and the locals have been left to deal with the consequences of subsiding homes and environmental pollution.

I thought they were stealing coal at first. I saw one old man leading six old women down to a fork in the road, moving like sprinters who'd just heard the starting gun. Upon reaching the road, they stopped to beg an approaching lorry for money.

The driver reaches down to hand over some loose change. The woman doesn't count it. The five blocking the lorry step aside and it drives on. Some drivers speed up as they approach, passing before they can reach the road. They stop work at 6pm, having earned 21.80 yuan (US$3); just over three yuan (half a dollar) each.

Few people live in the village now; you just see the occasional older person or a child. The dogs bark incessantly at strangers. Passing coal lorries or buses stir up clouds of black coal dust, forcing passers-by to cover their faces and flee.

Asi smokes by the ventilation shaft of an abandoned mine. He doesn't see what else he can do. His home is a small brick building near a mine pit. Now mining has stopped the pit has become a small lake. His home is riddled with cracks. Unstable homes back on to mining pits, which have filled with water now the mines are abandoned. The houses are crumbling with cracks wide enough in points to insert three fingers into. The concrete floors are loose and uneven.

Pingxiang is known as the coal capital of southern China. The area flourished after the foundation of the People's Republic, thanks to coal, and at one point there were 1,000 mines operating here. But a century of mining has exhausted the reserves and left the villagers with major subsidence problems.

The Juyuan mine was owned by the Pingxiang Coal Group and was part of China's planned economy. As subsidence in the village worsened, many people were

Large numbers of building in Lengshui, Hunan, are dangerous due to subsidence caused by mining. In 2015,a building in the township of Duoshan split down the middle

relocated en masse to a place called Wuliting in the city's Xiangdong district.

The "workers' villages" now stand empty. But not everyone from the village was moved. Local officials say that there wasn't enough money, and so residents whose homes were badly affected were moved first, with the others only given a one-off payment of 1,000 - 2,000 yuan (US$145 - US$290) to cover repairs and told to wait for reassessment in the future. They've been waiting over ten years, and have received no more compensation.

It's not just subsidence that's a problem; pollution also casts a shadow over the village. There are slogans on the walls of the buildings calling for villagers to use stoves designed to prevent indoor fluorine pollution; the pollutant is released from burning coal, and high levels in the air and drinking water causes fluorine poisoning, staining teeth and leading to skeletal fluorosis, causing pain and damage to bones and joints.

Some of the residents still waiting to move have huge cracks in their walls – in many cases the cracks are getting bigger, and doors and windows no longer open. Some people are too scared to sleep at night.

All the surface water here flows down into abandoned mines, leaving the villagers forced to use the muddy water which flows off the hillsides. After repeatedly complaining, they were able to use groundwater from the mines, but that water has high levels of calcium and they're worried it might not be safe. They have to travel three kilometres to get water or go into town to buy bottled water.

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Stam Lee is a freelancer photographer.

中国能源“十三五”再度调高低碳目标

中国政府发布十三五能源规划，在数年之内又一次提高低碳雄心，凸显能源转型紧迫性。

□ 马天杰

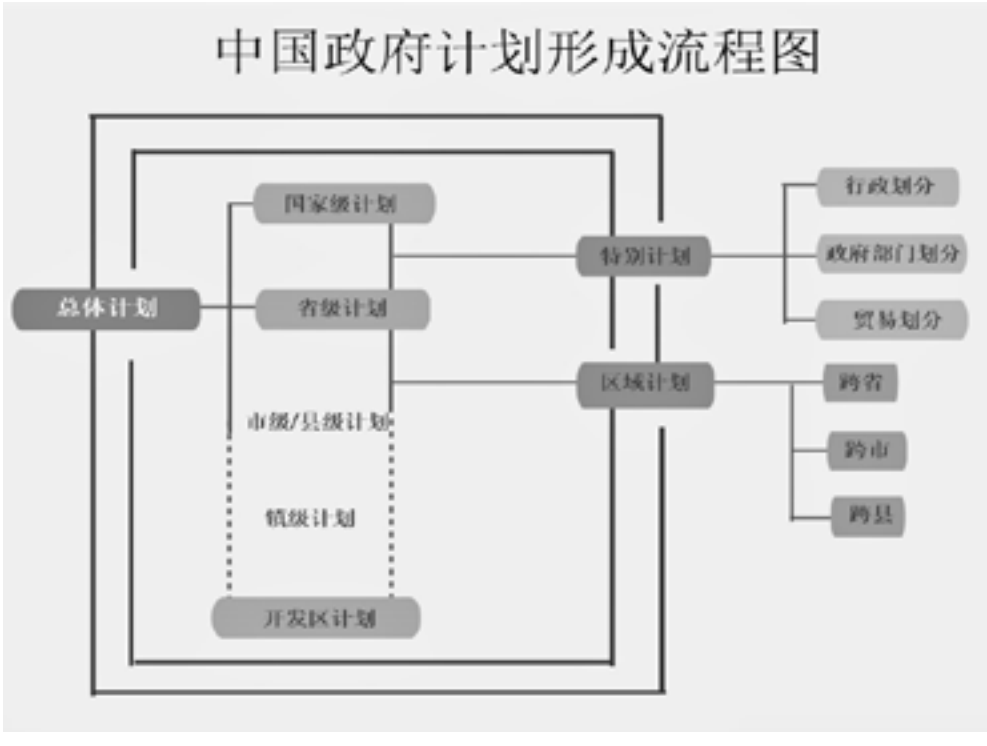
中国的能源“十三五”规划可能是世界上最受关注的能源发展蓝图之一。它对于中国这个世界第二大经济体和最大的碳排放国未来五年的碳足迹将带来深远影响。1 月 5 日，国家能源局终于公布了这份广受期待的计划中所涉及的关键目标，涉及从能源消费总量到风电装机容量的一系列 2020 年指标。在我们详解这份计划之前，有一点值得注意的是：通过能源“十三五，”中国可能又一次调高了自己的低碳雄心，凸显出这个饱受雾霾困扰的国家急于实现能源转型的迫切心情。

十三五规划体系

大家应该还记得，去年 3 月中国发布了《国民经济和社会发展第十三个五年规划纲要（2016-2020）》。这其中就包括了一系列的气候与能源目标，比如设置能源消费上限，以及将非化石燃料在国家一次能源构成中的比例提高到 15% 等等。

如果我们将这份“顶层计划”看作中国未来五年（2016-2020）的全面发展规划，那么十三五能源规划就可以看作是能源领域的“子计划”。这份规划将包括更多分解目标，从而更好地引导能源部门的政策制定、公共支出、以及项目规划。

下图展示了中国规划制定的层级结构：“十三五”能源规划是一项针对特定领域的专项规划，规划步骤位于国家整体规划之后。



能源“十三五”详解

下表展示了中国政府在《能源发展战略行动计划（2014-2020）》和“十三五”规划中已经明确的诸多2020年的气候与能源目标。我们将2015年末的实际水平作为参照与这些目标并置。将十三五能源规划中的目标与它们进行对比，有助于我们判断这些目标是否具有足够的雄心并足以确保落实中国对国内外的各项承诺。

“十三五”能源规划的大多数目标都不是全新的。许多其实都与此前公布的政策一脉相承，尤其是《能源发展战略行动计划（2014-2020)》。《战略计划》发布之时就对煤炭消耗和二氧化碳排放做出了超出国际预期的限制，这样的努力可谓魄力十足。

然而，决策机构似乎要下决心进一步缩减煤炭在整个国家能源构成中的比重，预计2020年煤炭在一次能耗中的比例将从62%下降到58%甚至更低。

此外，中国还是致力于进一步加快可再生能源发展。2020年风电与太阳能发电装机总量将分别达到2.1亿千瓦和1.1亿千瓦以上，高于2014年年末公布的目标。

如果我们回顾中国从2009年哥本哈根气候大会以来公布过的多个能源与低碳目标，就会发现：

- 中国曾多次主动调高自身设定的低碳目标
- 中国超额完成了大多数的2015年低碳和能源目标，并使得其2020年目标越来越具有雄心
- 相比全球其他主要经济体，中国的碳排放强度削减目标是最为激进的

如果将中国的这种姿态置于全球其他主要排放国的背景之下，尤其是美国在气候问题上的可能退步，中国的这种进取尤为引人瞩目。

挑战

但雄心勃勃的目标并不会自动转化成实打实的结果。如果要在不到五年之内实现能源“十三五”目标，中国仍需克服很多障碍。媒体有关“十三五”能源规划的报道同样揭示了困扰中国决策机构的那些深层担忧。

产能过剩：中国的电力部门面临着严重的产能过剩问题。总体经济下行与能源密集型产业疲软导致电力需求增长放缓，现有发电机组出现大面积利用率不足现象，利用小时数跌入自1978年以来最低水平。

然而，中国政府在此前经济快速发展时期批准了大量燃煤发电项目，再加上煤价下跌和政府固定电价导致煤电利润不降反升，这样的前期惯性和逆向刺激导致目前中国的燃煤电厂建设反而继续大步向前。

2020年目标	《能源发展战略行动计划（2014-2020）》	“十三五”规划	“十三五”能源规划	2015年实际水平值
能源消耗总量上限	大约48亿吨标准煤	50亿吨标准煤	不超过50亿吨标准煤	43亿吨标准煤
单位GDP能源消耗	不适用	相比2015年水平下降15%	不适用	相比2010年水平下降18.2%
单位GDP二氧化碳排放量	不适用	相比2015年水平下降18%	不适用	相比2010年水平下降20%
一次能耗的煤炭占比	62%	不适用	58%以下	64%
一次能耗的非化石燃料占比	15%	15%	超过15%	12%
风电装机容量	2亿千瓦	不适用	2.1亿千瓦	1.29亿千瓦
太阳能发电装机容量	1亿千瓦	不适用	1.1亿千瓦	4.3亿千瓦
水电装机容量	3.5亿千瓦	不适用	3.8亿千瓦	3.2亿千瓦
火电装机容量	不适用	不适用	11亿千瓦以内	9亿千瓦

这样的状况曾促使监管机构考虑在“十三五”能源规划中设定为期两年的“冰冻期”，不再批建新的燃煤电厂项目。而在最新公布的计划中，国家能源局官员明确了力争将煤电装机控制在 11 亿千瓦以内的目标，并表示要压缩新增煤电装机规模。

弃风弃光：煤电产能过剩的另一面却是可再生能源领域的弃风弃光现象，尤其是西部地区的风能和太阳能产业。

传输瓶颈和电力市场配置问题导致大量可再生电力无法成功并入电网。仅 2015 年风能发电总量中有 15% 被浪费，达到历史最高水平。“十三五”能源规划显示，相关决策机构将会将重心优先放在遏制这一趋势。另外，政府也已将未来五年新增风电和太阳能发电装机向中东部地区倾斜，减少未来的可再生能源自西向东的传输压力和可能造成的瓶颈。

马天杰，中外对话运营副主编

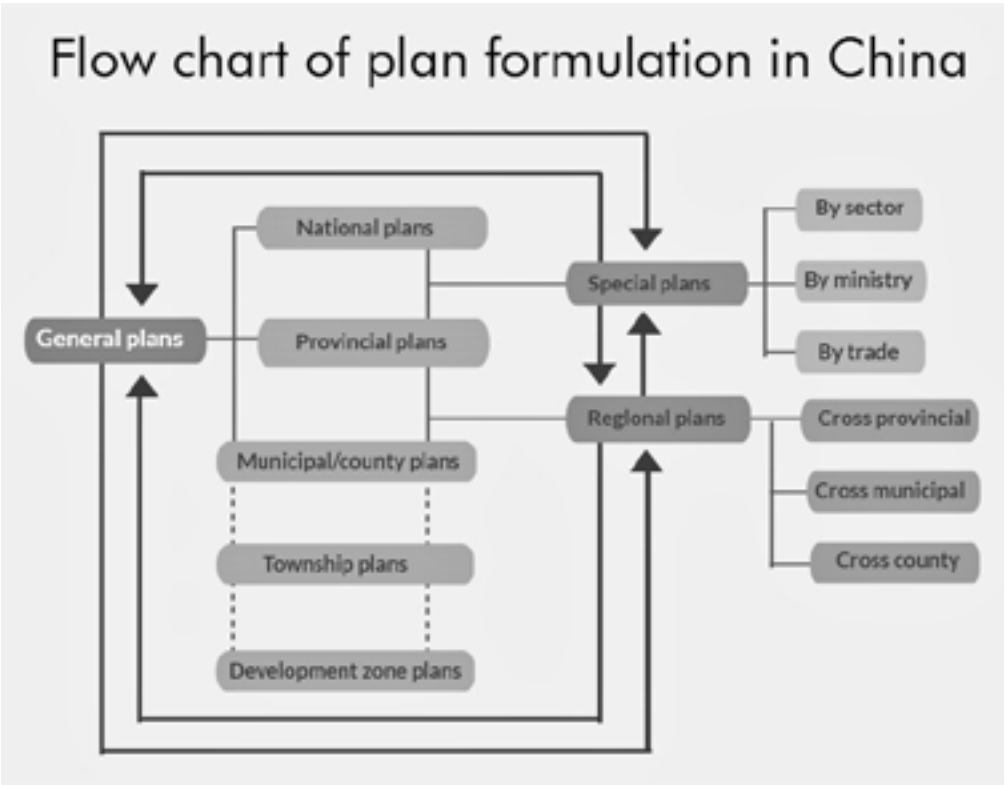
China raises its low carbon ambitions in 2020 targets

China unveiled its 13th Five-Year-Plan on energy development with the most far-reaching aims yet

□ Ma Tianjie

China's 13th Five-Year-Plan on Energy Development (Energy 13FYP) might be one of the most anticipated energy blueprints in the world for its far-reaching implications for the carbon trajectory of the planet's largest emitter.

On Jan 5, 2017, the National Energy Administration finally unveiled the plan to reporters, with a set of 2020 targets covering everything from total energy consumption to installed wind energy capacity. Before we



Courtesy of WWF China, "The 12th Five Year Plan: the formulation of China's major plans and programs 2008-2010 and onwards"

delve into details of the plan, one thing is worth noting: with the Energy 13FYP, China might have once again raised ambitions for its low-carbon future, highlighting the urgency that this smog-ridden country attaches to moving away from fossil fuels.

What's with all the FYPs?

Our readers may remember that in March, China unveiled its 13th Five-Year Plan for Economic and Social Development (2016-2020), which contains a set of climate and energy related targets, including an energy consumption cap and a 15% goal for the share of non-fossil-based energy in the country's primary energy mix. So what's the connection between this plan and the Energy 13FYP?

If we consider this the "Master Plan" for all aspects of China's development in the next five year period (2016 – 2020), then the Energy 13FYP is the breakdown of that Master Plan for the energy sector, with more detailed targets to better guide policymaking, government spending and project planning in the sector.

The chart below illustrates the hierarchy of Chinese government planning; the Energy 13FYP is designated a "special plan" for a specific sector.

What's in the Energy 13FYP?

The table illustrates the numerous 2020 targets already announced by the Chinese government in its Strategic Energy Action Plan (2014-2020) and its national 13th Five-Year Plan. They are cross-referenced with actual levels at the end of 2015. Comparing these to the latest targets is a way of gauging changes to the scale of ambition.

From this comparison, it appears that most of the Energy

2020 Targets	SEAP (2014-2020)	National 13FYP	Energy 13FYP	2015 actual levels
Total energy consumption cap	about 4.8Gtce	5Gtce	no more than 5Gtce	4.3Gtce
Energy consumption per unit of GDP	N/A	-15% from 2015 level	N/A	-18.2% from 2010 level
GO2 emissions per unit of GDP	N/A	-18% from 2015 level	N/A	-20% from 2010 level
Percentage of coal in primary energy consumption	62%	N/A	less than 58%	64%
Percentage of non-fossil fuel in primary energy consumption	15%	15%	more than 15%	12%
Wind energy installed capacity	200GW	N/A	more than 210GW	129GW
Solar energy installed capacity	100GW	N/A	more than 110GW	43GW
Hydro energy installed capacity	350GW	N/A	380GW	320GW
Coal energy installed capacity	N/A	N/A	less than 1100GW	900GW

Source: chinadialogue

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13FYP targets are not entirely "new". Many are in line with the existing thinking of previous announcements, in particular the Strategic Energy Action Plan (2014-2020), which, at the time of its publication was already considered ambitious in curbing coal consumption and CO2 emissions beyond international expectations.

However, this time round, policymakers seem even more determined to squeeze out coal's share in the country's energy mix, lowering its 2020 percentage in primary energy consumption from 62% to 58%.

The country is also aiming higher for renewables: installed capacity of wind energy and solar energy should reach "more than 210GW" and "more than 110GW", respectively, by 2020; higher than what was declared at the end of 2014.

A quick look back at the progress of China's energy targets since the 2009 Copenhagen climate summit, it is clear that:

• China has repeatedly strengthened its decarbonisation and low-carbon energy targets.

• China exceeded most of its 2015 low-carbon energy and decarbonisation targets and has made its 2020 energy and emissions targets more ambitious over time.

• It plans to reduce "emissions intensity" (the volume of emissions produced relative to economic activity) by more than other major economies.

Set against the background of other major emitters, particularly the United States' potential backtracking from its climate commitments, China's continued strengthening of its own targets looks even more remarkable.

Challenges

But ambitious targets do not necessarily translate into results. To achieve these goals in less than five years, China would have to overcome chronic problems in its energy sector. Media reports about the Energy 13FYP reveal deep-rooted concerns that have troubled Chinese policymakers.

Overcapacity: China's power sector is faced with a severe overcapacity problem. Slowing demand for electricity due to the economic downturn and the slashing of energy intensive industries has caused widespread under-utilisation of existing power generation capacities, which are seeing their lowest utilisation hours since 1978.

Yet the country is still seeing a fast build-up of coal-fired power capacity as a result of inertia (many projects were approved in the heyday of the economic boom), and perverse incentives (dropping coal prices and a government fixed electricity tariff is increasing the profit margin for coal power).

The situation has prompted regulators to consider putting a two-year "freeze period" in the Energy 13FYP for the approval of any new coal-fired power projects. At the press conference to launch the Energy 13FYP, government vowed to keep coal power capacity below 1100 GW by 2020, setting an upper limit for new coal capacity.

Curtailment: The other side of the overcapacity coin is curtailment of renewable energy, particularly wind and solar energy in western parts of the country.

A combination of transmission bottlenecks and market set-up has prevented large chunks of renewable electricity from reaching the grid. In 2015, 15% of China's wind energy was wasted, a record high. Based on the Energy 13FYP, the problem seems to have pressed policymakers to put more emphasis on reining in curtailment, as opposed to further expansion of installed capacity. It has also prompted them to plan more new renewable electricity capacity in China's eastern regions, where electricity demand is concentrated, reducing the need to transmit renewable energy across the country.

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储能技术能加速中国可再生能源发展吗？

储能技术可以促进更多可再生能源接入电网，但电力市场的变革是前提。

□ 查尔斯·韦斯特

2016年又是中国可再生能源发展取得标志性进步的一年，但清洁电力依然面临并网难的困境，比如，中国北部和西部地区的风力发电机往往长时间处于闲置状态。

针对上述情况，中国政策制定者已经开始探索采用储能技术来提升电网接纳风电和太阳能发电的能力。

但要大幅度提升可再生能源在中国能源构成中的比例，中国电网的运营方式需要根本性的改革。储能技术自身究竟能在多大程度上减少弃风，确保可再生能源不被浪费，我们对此抱有疑问。

储能技术在中国

储能方式主要包括电池、热储存、抽水蓄能等，是通过在电力需求低时储电，在电力需求高时放电的方式帮助电网更好地融合风电和太阳能发电的一种技术。储能技术增强了电网的灵活性，保证可再生能源发电厂持续工作，避免弃风弃光弃水等现象发生。

中国已认识到储能技术的价值，计划快速提升其电力存储能力。一方面，官方正在呼吁加快抽水蓄能设施的建设步伐。所谓抽水蓄能是指将水抽到高处的蓄水池中储存，需要时再开闸放水，利用水力涡轮发电的一种蓄能方式。水电发展“十三五”规划提出，到2020年之前将抽水蓄能装机从2300万千瓦提升到4000万千瓦，而这一数字大约是美国现有抽水蓄能装机的两倍。

另一方面，新兴储能技术也正在得到推广。2016年3月，中国发布《能源技术革命创新行动计划（2016-2030年）》，提出深化对面向可再生能源并网、微电网、及电动汽车应用的先进储能技术的研究。

示范项目已经在推进当中。2016年4月，大连储能电站项目获得国家能源局的批准，由中国电池生产商大连融科承建的这个20万千瓦的全钒液流储能项目将于2018年完工。届时，该项目将使中国的并网储能能力在目前的基础上增长三倍。政府规划部门希望，该系统可以帮助解决东北地区的弃风限电问题，并为电网提供备用能源和其他服务。

鼓励私人投资

中国还出台了新的试点机制，鼓励私人资本参与储能项目的投资。此前，储能电池企业获得商业成功的渠道非常少，要么开发小规模的示范项目，要么只能在偏远地区和岛上等高电价地区设点。

但2016年6月，国家能源局（NEA）宣布在弃风弃光现象最为严重的三北地区进行电力辅助服务补偿机制试点，对储能服务提供商提供的调峰调频辅助服务提供资金支持。

该机制借鉴了目前燃煤电厂调峰服务所采用的有偿机制。中国北方地区白天利用燃煤发电，同时向供暖管网提供暖气。但遗憾的是，燃煤电厂并不能轻易开工或停产，夜

间即便不再需要也必须保持运行。虽然火电效率更低，但被要求限电的最终还是风电场。

目前，政府会对发电产能降到一定水平以下的燃煤电厂予以补偿。而新的补偿机制的不同之处在于，不是对减产的燃煤电厂进行补偿，而是花钱鼓励储能服务提供商吸纳多余的电能。这样一来，不仅可以减少持续运行的燃煤电厂数量，还可以使运行着的燃煤电厂的发电效率提高，减少弃风，节省电网资金。

由于中国的能源行业仍处于转型阶段，储电补偿机制未来是否会发生进一步的变化仍不明朗。尽管如此，这一机制清楚表明，施政者已经做好了推广利用先进储能技术的准备。

改造电网

储能技术可以极大地加快可再生能源的并网步伐。但在风能和太阳能整体占有率低的情况下，减少弃风弃电并非当务之急。相反，优化电网运行才是推进光电和风电并网的关键。美国国家可再生能源实验室的一项研究认为，风电在美国能源中的占比可以达到 20% 以上，而不会产生严重弃风，也不需要大规模储电设备。相比之下，中国国家能源局数据显示，2016 年中国的风电占比仅为 4%，但吉林、新疆、甘肃等风电大省去年的弃风率则分别高达 30%、38% 和 43%。

中国的弃风弃光问题在很大程度上是由于中国能源行业规划和运营的机制性问题。目前中国电网中很多通行做法仍然将煤炭作为计划经济的一部分加以强调，没有主动适应不断多元化的能源行业的需要。

这种方式往往会以牺牲可再生能源发电为代价来保护燃煤发电，造成了风能发电与输电规划之间的错配，导致中国西部的风能发电厂只能无奈闲置坐等输电线修建完毕之后才能将电力输送到中国东部地区的电力需求中心。中国的配电方式还造成了省级电网各自为政，无法灵活地平衡各省之间的电力供给和需求。目前，国家政策鼓励各省级政府以消纳省内电力以支持各自的税收，并且为了保护各地火电企业的利益，反对从风能丰沛的省份引入风电。

中国要实现空气质量和碳排放的目标，就必须首先解决这些阻碍清洁能源并网的制度性障碍。但决策者发现，减少弃风弃光现象所需要的改革推行起来并不容易。虽然中国在 2015 年启动了新一轮的能源行业改革，但诸如基于边际成本优化能源输配等有助于增加可再生能源利用率的措施仍然举步维艰。

储能技术或许是应对弃风弃光问题的具有吸引力的解决方案，特别是在新的储能技术价格持续下降的情况下。但考虑到现有的电力体制问题，该技术仍然只是帮助决策者扩大可再生电能并网的众多工具之一。

市场阻碍仍在

但是要真正做出改变，就要向储能设施开发商发出正确的投资信号，并对市场进行改革。

虽然国家针对北方地区出台了新的储能服务补偿机制，但行业观察家认为，中国电力现货市场的缺位阻碍了储能技术的推广。

“现货市场一个重要的用途就是以波动的真实价格出售电力。”中国能源研究会储能专业委员会秘书长张静表示。

此类市场似乎正在酝酿当中：“十三五”能源行业规划提出到 2018 年之前开展现货市场试点项目，到 2020 年之前在全国推广。

但还有一些观察家指出，设计一个有效的现货市场十分困难。为各国政府提供清洁能源政策顾问咨询服务的全球性非政府组织——国际电力监管援助计划（the Regulatory Assistance Project）的专家王轩和麦克斯·迪普伊认为，“中国在建立现货市场竞争性竞价机制上将面临独特的挑战。能够推动增强行业透明度、监督和执行的机构目前能力不足，而国有企业主导着整个行业。”

这表明，储能服务提供商短时间内还不太可能看到他们的产品改变中国弃风弃光现状。

除了能够解决弃风弃光问题，储能技术还能在中国未来的电网发展中发挥其他的作用。储能技术有助于降低输配电网络升级的成本，提供备用能源，并解决小范围的供需失衡问题。简言之，这些技术可以创造一个更为可靠、性价比更高、更为清洁的电网。

但这一切的前提是推行正确的政策和监管措施，改革现有的电力市场。

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China turns to energy storage to push renewables

Energy storage could boost renewables if government follows through with major power market reforms

□ Charles Vest

Despite another banner year for renewables growth in China, the country's grid is still struggling to bring clean electricity to consumers. The problem is so serious in China's north and west that turbines were forced to sit idle for much of 2016.

In response, China's policymakers are now turning to energy storage to boost the grid's ability to accommodate wind and solar power.

But significantly increasing the share of renewables will require big changes in how China operates the grid, raising questions about how much of a role energy storage will play in ensuring that renewable energy is not wasted through curtailment.

China's energy storage push

Energy storage technologies – which include batteries, thermal storage, pumped hydro, and more – can help integrate wind and solar on to the grid by storing energy when power demand is low, and discharging power when demand is high. Energy storage adds flexibility to the grid, allowing renewables to generate power when they would otherwise be curtailed.

Recognising this value, China's policymakers are planning a rapid expansion of the country's energy storage capacity. To start, policymakers are calling for new construction of pumped hydro storage facilities, which store energy by pumping water uphill into reservoirs where it can later flow down again through turbines to generate electricity. The 13th Five-Year Hydropower Plan calls for an increase in pumped hydro storage from 23 gigawatts to 40 gigawatts by 2020 – about double the existing pumped hydro capacity of the United States.

The government is also promoting emerging energy storage technologies. In March 2016, the central government released a fifteen-year Energy Technology Innovation Action Plan calling for further research into advanced energy storage to support renewables integration, microgrid development, and electric vehicles.

One such demonstration project is already underway. In April 2016, the National Energy Administration approved the construction of a giant energy storage project in the northeast city of Dalian, where Chinese battery manufacturer Dalian Rongke is now building a 200-megawatt vanadium redox flow battery facility – a system so large that it will nearly triple China's present grid-connected battery capacity when it is completed in 2018. Government planners hope that the system will help address renewable energy curtailment in the region, in addition to providing back-up power and other services.

Private investment

The country is also piloting new mechanisms to encourage private investment in energy storage. Until recently, battery storage companies have had few avenues for commercial success. Nearly all deployments have been small-scale demonstration projects or installations in places where electricity is particularly expensive, such as remote areas and island grids.

But in June 2016, the National Energy Administration (NEA) unveiled an energy storage compensation scheme in northern China, where wind and solar curtailment is most severe. The programme pays energy storage providers for storing energy at night for use during the day.

The mechanism works by taking advantage of an existing paid service normally provided by coal plants, called peak regulation. In northern China, coal generation is used to provide electricity during the day and to provide essential heating through district heating networks. Unfortunately, coal plants cannot be turned on or off easily and so must remain operating at night even when they're unneeded. Although it's less efficient, wind generators are asked to curtail power instead.

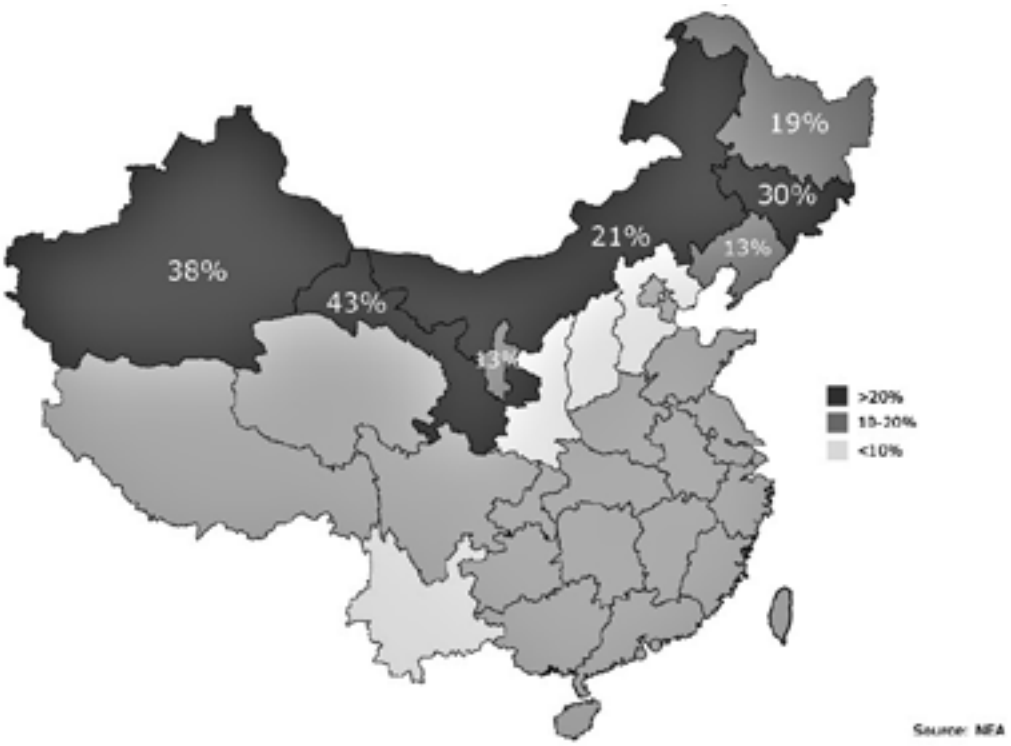
Currently, coal plants are compensated for having to ramp down power beyond a certain level. But instead of paying coal plants to not produce electricity, the new compensation mechanism pays energy storage to absorb excess power. This means fewer coal plants in operation, more efficient coal-burning in those coal plants that remain operational, less wind curtailment, and a financial saving for the grid.

Because China's power sector is in a transition state, it is still unclear how compensation for storage will change in the coming years. Nonetheless, this mechanism is a strong indicator that policymakers are ready to put advanced energy storage to work.

Adapting the grid

Energy storage can do a lot to help integrate renewables on to the grid. But at low levels of wind and solar penetration, it's not strictly necessary to prevent curtailment. Instead, optimising grid operations is the key to integrating solar and wind power. A US National Renewable Energy Laboratory study concluded that over 20% of electricity in the US

Wind Curtailment In China, 2016



could come from wind generation without significant curtailment or the need for energy storage. By comparison, wind accounted for only 4% of China's electricity production in 2016, yet provinces with high deployments of wind generation like Jilin, Xinjiang and Gansu respectively wasted 30%, 38% and 43% of their potential wind output last year, according to the NEA.

Much of China's curtailment challenge arises from institutional problems in its power sector planning and operations. Many of the practices that govern China's grid today still prioritise coal as part of a planned economy rather than adapting to the needs of a diversified power sector.

This approach has tended to favour coal-fired generation at the expense of renewable generators. It has led to a mismatch between wind generation and transmission planning, which has left western wind farms sitting idle while waiting for transmission lines to be built to carry power to China's demand centres in the east.

China's approach to electricity dispatch has also Balkanized the country's grids into provincial networks with inflexible means of balancing power supply and demand across the country. At the moment, provincial governments are incentivised to dispatch power locally to support their tax base and oppose importing renewable energy from wind-rich provinces to protect the financial health of local fossil fuel generators.

Addressing these institutional barriers to clean energy integration is crucial to meeting the country's air quality and carbon emissions targets. Yet policymakers have found it difficult to implement the reforms needed to reduce curtailment. Although China introduced a new round of power sector reforms in 2015, some changes that would increase renewable energy utilisation – such as optimising power dispatch based on marginal cost – have been slow-coming.

Energy storage may be an attractive engineering solution to curtailment, especially as the prices of new energy storage technologies continue to fall, but given the political challenges it will remain one tool among many to help policymakers bring more renewables on to the grid.

Market barriers persist

But to make an impact, energy storage developers need the right investment signals and market reforms.

Despite the new storage compensation mechanisms in northern China, industry observers argue that China's lack of electricity spot markets is hindering the widespread deployment of storage

"One important use of spot markets is to sell electricity at its true price as it changes with time," writes Tina Zhang, secretary-general of the China Energy Research Society's Energy Storage Committee.

These markets appear to be on the way: the 13th Five-Year Power Plan calls for pilot spot markets by 2018 and nationwide implementation by 2020.

But some observers contend that designing an effective spot market will be difficult. "China will face particular challenges in establishing competitive bidding in spot markets," according to Wang Xuan and Max Dupuy, power sector reform experts at the Regulatory Assistance Project, a global NGO that advises governments on clean energy policy. "Institutions to support transparency, monitoring, and enforcement are somewhat lacking in capacity, and state-owned enterprises currently dominate the industry."

This suggests that energy storage providers will have to wait before their products can make an impact on wind and solar curtailment in China.

Beyond addressing curtailment, energy storage may end up serving other roles in China's future grid. Energy storage can help reduce the costs of upgrading transmission and distribution networks, provide back-up power and address small imbalances in supply and demand. In short, these technologies can create a more reliable, cost-effective, and clean grid.

But until the right policies and regulations are put into action, China's renewables-friendly future remains remote.

Charles Vest is a writer, translator and clean energy analyst based in San Diego, CA.

另辟蹊径削减中国工业产能过剩

水泥企业结成同业联盟，协调合作共同解决产能过剩的路径值得推广到其他重工业。

□ 谭 浩

中国政府2016年的工作重点之一是减少钢铁、煤炭、水泥等高污染行业的过剩产能。

此举针对六大重点能源密集型行业：钢铁、有色金属、建材、石化、化工以及电力，其中大多数近年来遭遇了严重的产能过剩问题。2010年这六个行业占中国工业总能耗的77%。

这些行业的产能过剩被认为是中国工业利润下降的原因，贸易伙伴还因此指责中国造成了“全球市场的扭曲”。

政府的方案似乎起到了作用。官方数据显示，钢铁以及煤炭开采行业都已提前实现了2016年的去产能目标，压减粗钢产量4500万吨，退出煤炭产能2.5亿吨，而中国2015年共生产了大约8亿吨粗钢和37亿吨煤炭。

但水泥产业的去产能步伐更为缓慢。事实上，今年水泥产量不降反增。因此有人认为，相比其他行业取得的进展，水泥行业并没有解决产能过剩问题。

然而，如果我们将目光从近期数据转移到这些产业未来几年去产能的前景上，就会发现中国的钢铁和煤炭行业未来将面临更大的挑战，而水泥行业却显示出积极迹象。这是因为水泥是一种特殊的产品，具有独特的市场特性。

去产能路径将遇瓶颈

那么，中国钢铁和煤炭行业去产能接下来会遇到什么困难？

首先，这些行业目前取得的去产能成果实际上并没有看起来的那么成功。据财新网近期报道，被列入中国政府2016年去产能目标中的许多钢铁厂实际上长期处于“闲置或停产”状态。这些本就无效的产能去掉后，2017年以及之后的去产能工作难度会更大。另外，关停煤炭和钢铁厂的动作有中央政府大量的资金支持，包括总额1000亿元的（约合145亿美元）专项基金。水泥等其他行业则没有这样的支持。

但也许更重要的是，煤炭和钢铁行业采取的两种削减过剩产能的方式都存在重大局限。

第一种方式属于行政手段，一些批评意见认为这种方式过于武断和不可持续。例如，中国政府今年发布的一项政策要求煤矿全年运营时间不得超过275天。这实际上将煤炭开采生产能力降低了16%。但不幸的是，今年11月，由于煤炭供应短缺，政府又不得不放松限产的要求。

至于钢铁行业，一些专家认为很多采用低级技术、生产低质量产品的小型钢铁厂应该首先被关停。但是，这些小厂由于根本没有注册而未被列入去产能企业官方名录，从而逃脱了监督。

第二种削减产能的方式则是依靠市场竞争。但这种方式也存在问题。理论上，经营效率最低、成本最高的企业会因为竞争失败而被迫关停，但在实践中，这需要环保、产品质量、安全等方面的法律法规能够得到有效落实。

虽然中国在不断完善执法工作，但很多产品的价格仍然不能充分反映真实的生产成本。也就是说，一些企业的生产行为是以牺牲公众以及对社会和环境负责的企业的利益为代价的。

另外，企业从各自利益出发而开展的同业竞争也会导致负面的市场结果。面对不确定的市场前景，很多企业可能会不愿意从市场中退出而让其他企业获利，从而导致竞争企业之间相持不下。

经济模型显示，处于衰退期的行业中，往往是大型企业率先削减生产能力，因为他们维持市场份额的成本比小型企业更高。考虑到大型企业往往会采取更先进的技术，这样就可能导致整个行业技术水平下降。

管理和行为因素也值得考虑。管理人员可能会出于个人职业生涯的考虑而不愿削减产能或者彻底关停企业，即便企业本身已经缺乏竞争力，而撤资或许对于投资者最为有利。

同业联盟的去产能功效

我们认为，上述问题的一个解决办法就是鼓励企业间合作，共同削减产能。虽然人们常认为卡特尔（同业联盟）损害市场竞争，但在某些情况下卡特尔却可以发挥作用。

中国的《反垄断法》允许企业经营者之间在特定情况下一致行动，包括“因经济不景气，为缓解销售量严重下降或者生产明显过剩”，以及“为实现节约能源、保护环境、救灾救助等社会公共利益”等。煤炭、钢铁和水泥行业显然满足这些条件。

但推动这些企业自愿合作、共同削减产能则是另外一类问题。在煤炭和钢铁行业，这面临十分严峻的挑战。一方面，这两个行业中有大量分散在各地的独立企业；另一方面，某些企业希望“搭便车”，趁其他企业自愿削减产能而获利。

“处于衰退期的行业中，往往是大型企业率先削减生产能力，因为他们维持市场份额的成本比小型企业更高。考虑到大型企业往往会采取更先进的技术，这样就可能导致整个行业技术水平下降。”

水泥业独辟蹊径

但此类问题有望在高度区域化的水泥行业中得到解决。水泥主要是本地生产、本地销售，因为运输和分销成本在水泥价格中占很大比重。同一区域市场中竞争者的数量有限，因而更有可能在各方之间达成去产能协议。

已经有一些令人鼓舞的迹象表明，水泥行业可以用这种方法有效推进去产能。例如，山东省的水泥生产企业已经合作起来协调生产。在中国水泥协会的支持下，主要水泥生产商已经共同建立合资企业，推动省内水泥产能合理化。参与这一计划的企业均需自愿配合减产。

中国水泥协会也向工业和信息化部（MIIT）提出政策建议，认为应该建立专项基金，补偿自愿关停生产线的企业并帮助全国的水泥企业转产。水泥企业将根据各自的产量向基金注资。

历史经验

中国水泥行业还可以借鉴上世纪 80 年代英国钢铁铸造行业成功削减产能的经验。

如同上世纪七八十年代的其他行业一样，英国钢铁铸造行业也经历了产能严重过剩和结构调整。企业和政府共同出资建立基金，补偿自愿减产的企业。行业中每个企业均可选择是继续生产但向基金注资，还是推出但获得补偿。

与中国水泥行业正在考虑的方案不同，上述方案是由拉扎德投资银行设计和实施的。第三方的介入可以避免利益冲突，而金融机构的参与则有助于项目的执行，并降低了获得资金的难度。

正如策略学者查尔斯 · 巴登 - 富勒（Charles Baden-Fuller）记述的那样，这一项目的执行也并非一帆风顺，因为很多企业出于经济和管理方面的考虑并不愿意削减产能。不过项目最终还是取得了成功。1975 年，英国总计关停了 36700 吨铸造产能，占该行业总产能的 14%。

西方行业结构调整以及当前中国去产能的经验表明，行政手段和市场竞争并非解决问题的唯一方式。

对于水泥这样能源密集并且高污染的行业，应鼓励企业间通过合作以及协议的形式自愿去产能。政府和行业协会应该与企业密切合作，为实现这样的目标提供支持。

谭浩，澳大利亚纽卡斯尔商学院高级讲师，主要从管理学角度关注中国的能源与资源转型

There's another way to solve China's industrial overcapacity

Reducing excess supply in cement is easier than for coal and steel but cooperation among firms will be crucial

□ Tan Hao

A third way: Co-operative action by companies could support government policy to reduce capacity

A top priority for China's government in 2016 has been to reduce excess industrial capacity, a problem that is particularly evident in many energy intensive and polluting industries.

Six of those industries - including steelmaking, nonferrous metals, building materials, petrochemicals, chemicals, and electric power generation - accounted for 77% of total energy consumption of the entire Chinese industrial sector in 2010.

But today the oversupply of products, such as steel and coal, has been blamed for falling profits in Chinese industry, and led to accusations by China's trading partners that the country is causing "distortions in global markets".

That said, the plan to cut excess capacity appears to be working. Government data indicates that the steel, iron and coal mining industries have reportedly achieved their 2016 targets ahead of schedule. These were to cut 45 million tonnes of crude steel production and 250 million tonnes of coal, respectively. For comparison, China produced about 800 million tonnes of crude steel and 3.7 billion tonnes of coal in 2015.

But for the cement industry progress has been slower. In fact, cement production is up compared to last year, which suggests that the industry is failing to address overcapacity compared with the gains elsewhere.

But looking beyond the recent data towards the medium and long term prospects for reducing oversupply suggests that China's steel and coal industries may face greater challenges ahead, while the signs for cement are more promising. This is because of cement's unique product and market characteristics.

Flawed methods

So why will it be hard to tackle excess capacity in China's steel and coal industries?

Firstly, reductions made so far in these industries may not be as impressive as they appear. The Chinese business paper, Caixin, recently reported that many steelmaking factories that were targeted as part of the government's capacity reduction plan in 2016 had, in fact, been "idle" for years. This will make reductions in 2017 and beyond much harder as the low-hanging fruit has been picked. Furthermore, closure of coal and steel plants has been supported by significant funding from central government, partly through a 100 billion yuan (US$14.5 billion) special fund, inaccessible to other industries such as cement.

But perhaps more importantly, the two approaches to cutting excess capacity in the coal and steel industries have some important limitations.

The first approach consists of administrative measures that critics say are arbitrary and unsustainable. For example, the Chinese government issued a policy early this year requiring coal mines to operate less than 275 days per year, effectively reduced coal mining capacity by 16%. Unfortunately, the government had to relax the limit in November due to a shortage of coal.

In the steel industry, small steelworks that produce poor quality products have escaped scrutiny because they are not covered by an official list of registered steelworks.

The second approach to reducing capacity relies on intensifying market competition. In theory, firms that operate least efficiently and have the highest costs would be out-competed and forced to close. But in practice this requires the enforcement of laws and regulations with respect to environmental protection, product quality, safety and so on. Although China is improving in these respects, prices of many products do not yet fully reflect the true costs of production. In some cases, production comes at a cost to the public, and also to those companies that are more socially and environmentally responsible, thereby denying a level playing field.

> "While cartels are often viewed as undermining market competition, they can prove useful under some circumstances."

In addition, the nature of competition between companies in the same industry, in which each firm acts in its own interests, can lead to adverse market outcomes. In the face of uncertain market prospects, firms may be unwilling to exit from the market first and give others the advantage. The result is deadlock among competing firms.

Economic models suggest that it may well be large firms that cut production capacity first in a declining industry because they bear higher costs in maintaining market share than small firms. Given that large firms tend to employ more advanced technology, this scenario may lead to a reduction in technological competence at the industry level. Managerial and behavioural factors are also important. Managers may be reluctant to reduce capacity or close entirely because of career concerns, even when the company is uncompetitive and divestment may be in the best interest of investors.

A role for cartels

One solution to these problems would be to encourage cooperation among firms to jointly reduce capacity. While cartels are often viewed as undermining market competition,

they can prove useful under some circumstances.

China's Anti-Monopoly Law allows for an agreement among business operators under certain circumstances, including for the purpose of "mitigating serious decrease in sales volume or obviously excessive production during economic recessions"; as well as for "achieving public interests such as conserving energy, protecting the environment and relieving the victims of a disaster". The coal, steel and cement industries clearly meet these conditions.

But getting firms to voluntarily cooperate to cut capacity is another matter. In the coal and steel industries this would pose a significant challenge because there are a large number of independent businesses that are scattered diffusely among a large number of regions. There is an added risk that some firms would act as "free-riders" and look to take advantage of voluntary capacity closures by others firms.

The cement industry is different

Yet there is hope that such problems could be overcome in the cement industry because its market is highly regional. Cement is mostly sourced and sold locally because a large proportion of the price results from transportation and distribution costs. In a given regional market the number of competitors is limited, making an agreement among parties to reduce capacity more likely.

There are already encouraging signs that the cement industry can facilitate capacity closures. Cement manufacturers in Shandong province, for example, have been working together to coordinate production. With support from the China Cement Association, major cement producers have also been working towards establishing a joint investment enterprise that will help to rationalise cement production capacity in the province. Under the plan, participating firms make closures in a voluntary and cooperative manner.

The China Cement Association has also made policy recommendations to the Ministry of Industry and Information Technology (MIIT) to establish a fund to compensate firms willing to close production lines and to help businesses across the country transition into other activities. Cement companies would contribute to the fund according to their level of production.

Lessons from history

The Chinese cement industry could also learn from the experience of the UK steel castings industry in the 1980s, which successfully reduced capacity.

Like other industries in the 1970s and '80s, it experienced severe excess capacity and undertook a restructuring process. Firms established a fund based on contributions from the companies and government to compensate firms that voluntarily reduced capacity. Every player in the industry could choose either to contribute to the fund and stay, or take compensation and leave.

Unlike the plans currently under consideration in the Chinese cement industry, the initiative was designed and implemented by an investment bank, Lazard. By using a third party the arrangement avoided conflicts of interest, and the involvement of a financial institute helped to facilitate the process and ease access to financial support.

As documented by professor Charles Baden-Fuller of Cass Business School the implementation of the programme was not without difficulties because many firms were unwilling to close capacity owing to economic and managerial concerns. The programme was successful though. About 36,700 tonnes of casting capacity was closed, accounting for 14% of the industry's total capacity in 1975.

The lessons from industrial restructuring in the West and from current efforts to reduce overcapacity in China suggest that administrative measures and market competition are not the only ways to address the problem.

For energy intensive and heavily polluting industries such as cement, cooperation among firms and voluntary agreements for joint capacity closures should be encouraged. The government and industry associations should work closely with firms and provide support to achieve these goals.

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太阳能与电动汽车会改变现有能源格局吗？

随着太阳能光伏和锂电池成本的大幅下降，全球石油需求将在十年之内大幅减少。

□ 甘博赫·阿贾伊

自2015年12月《巴黎气候协定》通过以来，国际社会对抗气候变化的热情空前高涨。然而到底该如何从现有的化石燃料密集型生活模式转换到未来的低碳、甚至零碳模式，目前还没有定论。尽管如此，一些重大转变已经开始出现苗头。

关于太阳能光伏设备成本下降的讨论已经持续多年。目前来看，太阳能单位发电成本下降，不只是因为中国大规模增产导致全球市场供过于求，生产成本也的确在下降。

目前，太阳能光伏组件的成本不足每瓦0.5美元，而在美国安装全套的供电级太阳能光伏系统每瓦成本还不到1美元。此成就的取得，比美国能源部颁布的Sunshot计划所提出的宏伟目标提前了3年。过去十年，有部分研究预计，至少要到21世纪末，太阳能系统的成本才会锐减至这一水平。行业创新的速度的确比我们大多数人想象的要快得多。

锂电池产业也是动作不断。锂电池问世于上世纪90年代，如今已在便携式电子装置市场独领风骚。此外，锂电池也是年销售量有望突破50万辆的电动汽车领域的标配能源。

特斯拉集团的“超级工厂”已经投产，它是目前全球最大的锂电池生产厂商。特斯拉的大幅增产和削减电池成本的愿景正在成为现实。正如我们在一系列声明中所看到的，电动汽车的成本有望在2020年代初期与汽油和柴油汽车一拼高下。

> “目前全球最大的锂电池生产厂商“特斯拉”大幅增产和削减电池成本的愿景正在成为现实。电动汽车的成本有望在若干年后与汽油和柴油汽车一拼高下。”

技术创新和成本下降对于抗击气候变化工作又会产生什么影响？近期内这一趋势对化石燃料行业又有怎样的冲击？由帝国理工大学（Imperial College London）格兰瑟姆研究所（Grantham Institute）与碳追踪（Carbon Tracker）共同开展的一份最新研究试图回答上述问题。该研究不仅力图搞清未来30年全球化石燃料市场的状况，同时也根据最近几年的行业与科研进展为我们模拟了未来可能的全球升温情景。

按照现有状况计算，到2100年全球平均气温会上升2.5摄氏度左右。而且，这还需要大多数国家积极诚信地兑现各自的2030年巴黎气候承诺，比如至少对低碳技术予以适度支持，以及对化石燃料燃烧产生的环境破坏成本进行一定的考虑等等。虽然这要比在什么都不做的情景下，2100年全球平均气温上升幅度可能突破4摄氏度的情况好得多，

特斯拉的超级电池工厂“Gigafactory”降低了锂电池的成本。 一项新的研究表明，到2050年时电动汽车可支配70%的公路运输

但是要想达成《巴黎气候协定》设定的全球温度上升幅度“低于 2 摄氏度”的长期目标，我们还需做出更多努力。

上述研究显示，由于电动汽车和太阳能光伏产业的崛起，石油和煤炭在道路交通和发电市场的需求将遭受重创。到 2050 年，太阳能光伏在全球发电市场中所占的比例将达到 30%，而电动汽车则将占据 7 成的道路运输市场。所以说，到本世纪 40 年代，煤炭在电力产业或许将彻底丧失立足之地，而届时石油也将局限于公路货运、航空海运等领域。总而言之，上述两种化石燃料的全球需求将在本世纪 20 年代达到峰值。

从行业与宏观经济角度来看，这样的转变，尤其是石油需求的变化将会产生非常重要的影响。以本次研究发现为例，我们预计到本世纪 20 年代中期，电动汽车每天可减少 200 万桶石油需求，而这与最近石油价格暴跌导致的供需失衡数量基本相当。据我们估计，到本世纪中叶，电动汽车可减少十倍于此的石油需求。

当然了，这份研究带来的并不全是好消息。从积极的方面来看，未来新型低碳科技的市场渗透速度将继续加快，并在一定程度上减缓气候变化。我们将从“照常排放”的温度变化模式，转而进入一个升温较慢的模式。

然而，这一转变依旧无法让我们完成《巴黎气候协定》设定的目标。我们需要继续寻找和挖掘其他高性价比、易推广的科技来替代现有的化石燃料技术。就近期而言，如果化石燃料产业不能充分理解这一研究中提及的模式转变，并相应做出计划，那么，这个行业必将遭受深远的、甚至颠覆性的影响。我们必须睁大双眼观测未来的发展大潮，为应对不可预测的难题做好准备。

格阿贾伊·甘博赫，英国伦敦帝国理工学院格兰瑟姆气候变化与环境研究所高级研究员

Will solar and EVs transform our energy landscape?

Rapidly falling costs for solar PV and batteries will lead to major reductions in oil demand by the mid-2020s

□ Ajay Gambhir

Whilst international resolve to tackle climate change appeared at an all-time high after the Paris Agreement in December 2015, it's still not clear how we'll chart a path from our fossil fuel-intensive way of life to a low-carbon, possibly zero-carbon, future. But in the background of this international policy activity, big changes have been happening.

There has been a buzz around the falling costs of solar photovoltaics (solar PV) for many years now. It has become clear that reductions in the cost per watt is not just the result of China's massive scale-up in production and the resulting global oversupply, but also the result of manufacturing cost reductions.

> "We show that we're on a pathway that leads to an approximate 2.5C level of global warming by 2100."

Solar PV modules now cost less than US$0.5 per watt, whilst more importantly, the cost of whole installed utility-scale solar PV systems is below US$1 per watt in the US. This was achieved three years before the US Department of Energy's "Sunshot" programme targeted this ambitious goal. Some studies produced in the last decade didn't foresee such costs until the end of the 21st century so the rate of innovation is much faster than many thought possible.

Aside from solar PV, we've also seen a frenzy of activity around lithium ion batteries, which have gone from being a newcomer in the 1990s to completely dominate the portable electronic devices markets. Lithium ion is now the battery technology of choice in electric vehicles, whose annual sales are heading towards half a million units per year.

Tesla's "gigafactory", the world's largest lithium ion battery production plant, is now up and running, and Tesla's talk of scaling up production and driving down battery costs is coming to fruition, as we are now seeing a raft of announcements for electric vehicles that are expected to be

cost-competitive with petrol and diesel cars by the early 2020s.

So what does the innovation and cost reduction in these two key technologies mean for our efforts to tackle climate change? And perhaps more importantly in the near-term, what implications will these technologies have on the fossil fuel industry? The new study by the Grantham Institute at Imperial College London, in partnership with Carbon Tracker addresses these questions, with a view to understanding the global fossil fuel markets for the next three decades, as well as the temperature pathways that we might be on as a result of recent developments.

We show that we're on a pathway that leads to an approximate 2.5C level of global warming by 2100. This depends on most countries acting on their 2030 Paris climate pledges in good faith by implementing at least moderate support for new low-carbon technologies, and accounting for some of the damage done by burning fossil fuels. This is more promising than the many "business-as-usual" pathways that would see temperature changes in excess of 4C by 2100, but still leaves much to be done if we're to get to the "well below 2C" long term goal of the Paris Agreement.

More significantly, perhaps, the study shows that oil and coal demand could take a serious hit as a result of their falling importance in the road transport and electricity generation markets, crowded out by electric vehicles and solar PV, respectively. Solar PV takes a 30% share of the global power generation market by 2050, whilst electric vehicles take a 70% share of the road transport market by this time. For coal, this means it could have absolutely no role in the power sector by the 2040s, whilst oil would be confined to the road freight, aviation and shipping parts of the transport sector by this time. Both fuels would see their global demand peak in the 2020s.

These shifts, particularly in oil demand, could be extremely significant from an industry and macro-economic perspective. To put our study's findings in context, we are forecasting that electric vehicles will displace two million barrels per day of oil demand by the mid-2020s – which is the supply-demand imbalance seen during the recent oil price collapse. By 2050, electric vehicles could have displaced more than ten times this amount of oil, according to our assumptions.

This study has some good news and some bad, then. On the plus side, we're expecting a rapid penetration of new, low-carbon technologies to address part of the climate change challenge. This will shift temperature change pathways from traditional business-as-usual (an increasingly redundant concept) to lower-temperature pathways.

Unfortunately, this is still not enough to meet the ambitious Paris Agreement goals. So we need to think hard about which other technologies can be deployed cost-competitively and at scale to displace fossil fuel technologies. More importantly for the near-term, the shifts envisaged in this study could have profound and potentially destabilising consequences for the fossil fuel industry if they are not fully understood and planned for. It's time we looked to these future mega-trends with our eyes open, so as to expect the unexpected.

Ajay Gambhir is a senior research fellow at the Grantham Institute – Climate Change and the Environment, at Imperial College London

水电和生物质燃料真的“清洁”吗?

虽然属于可再生能源的范畴，但水电和生物质燃料生产所需要的水是化石燃料的成百上千倍。

□ 阿尔杰恩·Y·胡克斯特拉

冰岛的奈斯亚威里尔的地热发电厂

可再生能源转型经常被形容为一个政治和经济的双重挑战，是一场需要调动大量投资、撼动化石燃料经济中既得利益群体的艰苦斗争。但另外一个挑战受到的关注则要少得多：我们是否有足够的土地和水来支撑可再生能源的生产。

生物质能、水能、风能、太阳能和地热能都需要占用大量的土地资源和水资源，而这些都是有限的。对不同的可再生能源获取方式及其所需要占用的土地和水量进行更深入的观察，可以发现哪些能源方式在长远上更加可行。

生物质燃料的高昂代价

高度依赖化石能源，让“能源短缺”成为威胁我们经济发展和国家安全的一个心头大患。可再生能源似乎可以解决这个问题，因为单是太阳辐射就已经远超我们的需要。

实际上，太阳辐射加上从风、水流、生物质和地球内部热力获取的能量似乎就可以为我们提供永不枯竭的能源。但不幸的是，这只是一种误解，生物质能的例子可以说明原因所在。

将生物质转化为生物燃料需要各种自然资源，包括肥沃的土地、水和能量。但是，目前能源密集型的农业实践导致所投入的能源不比所生产的生物燃料少多少。即便能够实现显著的能源净收益，我们仍然需要投入大量的土地和水资源。据我们估算，如果第一代生物乙醇代替全球交通运输行业所用的化石燃料的10%，全球用水需求就会增加6-7%。

尽管我们所消耗的大部分水都被用来生产食品，但如果用生物燃料大规模替代化石燃料的话，未来能源生产会用掉更多的水。下一代以非食品作物、废弃物或水藻为原料的生物燃料虽然会有一定改进，但依然会得出相似的结论：生产生物燃料比我们消费等量的化石燃料需要更多的土地和水，而这已经超出了可持续供应量。而我们的土地和水足迹现在就已经超过地球可负荷的水平。

这样一来，能源短缺将变成土地和水资源短缺。

水电站的生态足迹

水力发电占世界供电总量的16%左右，通常被视为一种清洁的能源形式。但这并不意味着我们可以一味地增加水电，因为大坝会给河岸生态系统和社会带来严重影响。

建新大坝常常很困难，因为修建水库会导致另有用途的土地被淹没。中国修三峡大坝时，动迁了100多万人。水力发电也是一个耗水大户，因为水库会造成更大的蒸发，影响下游其他用途的可用水量。

其他形式的水力发电不需要修建大型水坝，它们依靠河水流动、海潮或河口的淡-海水盐度变化来发电。但这些只能是小规模的（至少从全球角度来看），而且由于此类能源的集中度较低，要将其集中起来成本高昂。

太阳能、风能和地热能

光伏和风力发电单位能量的水足迹是化石燃料和核电的百分之一到十分之一，地热发电也只有化石燃料的十分之一；然而集中式太阳能发电的水足迹与化石燃料相近，水力发电和生物质能则达到100到1000倍。

从水资源短缺的角度来说，我们究竟应该从化石燃料向生物能和水能，还是向太阳能、风能和地热能转化，真的非常重要。所谓的“绿色能源”发展方案却包含着生物能和水电的大幅增长，按照这种方案发展的话，能源产业的水足迹将“突破天际”。

为了实现真正的绿色转型，能源发展方案必须实现水足迹的不断减小，因此其主要发展方向应该是太阳能、风能和地热能。

从燃料到电力

当然，土地足迹同样重要。太阳能比生物质能更加高效，因为光伏板和集中式太阳能发电系统能比光合作用更有效地获取入射太阳辐射，因此每平方米产生的能量就更多。尽管光合作用的主要优势是生产出的是可储存能源，并且可以将其转化为高能量密度的生物燃料，而光伏生产出的是不可储存的电力。集中式太阳能发电系统也能利用热储能来储存能量，但其最终产品仍然是电力，而非燃料。

除了利用有机物质废料，其他形式的生物能并不是替代化石燃料的可持续方式。所以，我们不得不接受未来能源经济将日益依赖电力的事实。这意味着电力输送的重要性，也凸显了电采暖的光明未来，至少在那些工业或地热能多余热量无法解决采暖需求的地方。

这样的变化带来了新的挑战：如何储存能源，以及如何设计出能够应对电力供求巨大波动的电网。

太阳能、风能和地热能让我们有可能提升能源自给度，但相比我们在全球化的化石燃料经济的巨大规模，这些能源形式的规模小而分散。随着我们日益摆脱化石燃料，衷心希望我们有足够的智慧将投资注入那些真正可持续的解决方案，而不是将生物燃料如此高高置于政府政策的核心地位。经济的去碳化和降低水足迹可以是并行不悖的。

阿尔杰恩·Y·胡克斯特拉，荷兰屯特大学水资源管理学教授，新加坡国立大学李光耀公共政策学院客座教授

Is there enough land and water for renewable energy?

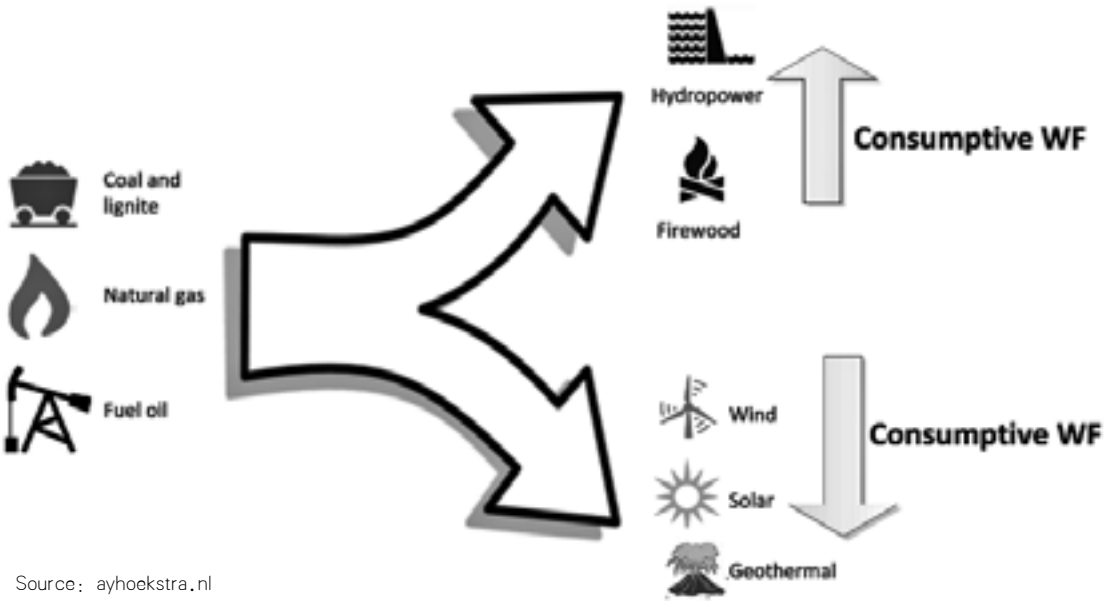
Producing energy from wind, solar and geothermal requires much less water than hydropower and biofuels

□ Arjen Y Hoekstra

The shift to renewable energy is often described as a political and economic challenge; a struggle to mobilise substantial investments and overcome vested interests that profit from a fossil-fuel economy. But there's another challenge that receives far less attention: do we have enough land and water to accommodate the production of renewable energy?

Bio-energy, hydropower, wind, solar and geothermal all require substantial land and water resources. And these are limited. A closer look at the different ways of capturing renewable energy and the amount of water and land they require reveals which energy scenarios are more feasible in the long run.

Change in water footprint from fossil energy to renewable sources



Source：ayhoekstra.nl

Biofuels

Our reliance on fossil fuels as the primary source of energy has led us to worry about "energy scarcity" as a major risk to economic development and national security. Renewable energy would seem to resolve this problem because incoming solar radiation alone is already so far beyond what we need.

In fact, solar radiation, together with the energy captured from wind, water flows, biomass and the internal heat of the earth, seem to offer an inexhaustible source of energy. Unfortunately, this is a misunderstanding. The case of bio-energy can illustrate why.

Producing biomass to turn into biofuels requires natural resources, including fertile land, water and energy. However, with current energy-intensive agricultural practices we sometimes need to input about the same amount of energy as will be produced in the form of biofuel. Even if there was a substantial net gain in energy, we would still need vast amounts of land and water resources. We estimated that if first-generation bio-ethanol replaced 10% of the fossil fuel used in global transport, world water demand would increase by about 6-7%.

While most of our water consumption still goes into producing our food, energy production could become a larger water consumer in future if we replace fossil fuels with biofuels at substantial scale. Using next-generation biofuels based on non-food crops, waste or algae may improve things, but the conclusion is similar: producing biofuels at the same volumes as we consume fossil fuels will require more land and water than are sustainably available. Even today we have land and water footprints beyond maximum sustainable levels.

Energy scarcity will thus be replaced by land and water scarcity.

Hydropower

Hydropower accounts for about 16% of the world's electricity supply and is generally seen as a clean form of energy. This does not mean that we can simply increase hydroelectric capacity though, because dams can heavily impact riparian ecosystems and societies.

Building new dams is often difficult because the creation of reservoirs inundates land that is usually in use for other purposes. When China's Three Gorges Dam was built, over one million people were displaced. Hydropower is also a large water consumer because the creation of reservoirs results in additional evaporation, affecting downstream water availability for other purposes.

There are other forms of hydroelectric generation that don't require enormous dams. They rely on river flow, ocean currents or from the freshwater-saltwater gradient in deltas. But these are small scale only – at least from a global perspective – and because of the low concentration of this sort of energy, it is expensive to concentrate it.

Solar, wind and geothermal

Per unit of energy, the water footprint of photovoltaic (PV) and wind energy is ten to a hundred times smaller than that of fossil fuels and nuclear, while the water footprint of hydroelectricity and bio-energy is a hundred to a thousand times larger. Electricity from concentrated solar power has a water footprint similar to fossil fuels, while geothermal can have a footprint that is similar to ten times smaller.

So from a water scarcity perspective it really matters whether we shift from fossil energy to bio and hydro or to solar, wind and geothermal energy. So-called "green" energy scenarios are based on substantial growth of bio and hydro in the mix, which means that the water footprint of the energy sector will grow sky-high if we follow such scenarios.

"From a water scarcity perspective it really matters whether we shift from fossil energy to bio and hydro or to solar, wind and geothermal energy."

To be truly green, energy scenarios must lead to a declining water footprint and so should be primarily based on solar, wind and geothermal energy.

The transition to electricity

Of course, the land footprint matters, too. Solar energy is more efficient than biomass because PV panels and concentrated solar power systems are more efficient in capturing incoming solar radiation than photosynthesis, and so generate more energy per square metre. The major argument for photosynthesis though is that it results in storable bioenergy that can be turned into energy-dense biofuels, whereas PV results in non-storable electricity. Concentrated solar power systems can store energy by use of thermal energy storage, but the final product is still electricity, not fuel.

Since substantial growth of bioenergy – beyond using waste streams of organic material – is not a sustainable answer to shifting away from fossil fuels, we have to accept that the future energy economy is going to be based increasingly on electricity. This implies electric transport. It also means electric heating, at least where surplus heat from industrial processes or geothermal energy doesn't offer a solution.

Such a shift creates new challenges: how to store energy and how to design electrical grids that can handle the large variability of both electricity demand and supply.

Solar and wind power, and earth's heat offer us possibilities to become more energy self-sufficient at much smaller scales than we are used to in our globalised fossil fuel economy. As we transition away from fossil fuels let's hope that we are smart enough to invest in solutions that are truly sustainable, unlike biofuels that have been so much at the centre of government policies. Decarbonising our economy can be combined with lowering our water footprint.

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从核灾现场到光伏电站：切尔诺贝利浴火重生

两家中国公司正将切尔诺贝利变为太阳能发电站，核灾旧址的重生标志着利用污染土地发展清洁能源已成趋势。

□ 珍妮·约翰逊

两家中国公司正于著名的切尔诺贝利核事故旧址兴建一座大型太阳能发电站，这显示在中国投资者的助推下，利用污染土地发展可再生能源或将成为全球趋势。

1986 年的切尔诺贝利核电站事故释放了相当于广岛核爆炸 400 多倍的放射性物质。30 年后的今天，乌克兰政府正在为一个即将落户辐射区的大型太阳能项目做准备。切尔诺贝利核事故造成周边乌克兰、白俄罗斯和俄罗斯的大片土地在几个世纪内都将受到辐射影响，有 30 多万人被迫迁离。

利用被工业生产和事故污染的问题土地建设风能和太阳能项目是一个新趋势，即便是反对用农业和公共土地发展可再生能源的人也有不少对此表示欢迎。拟建的切尔诺贝利太阳能电站装机容量 10 万千瓦。这样一座震惊世界的重大核灾难现场若能彻底改头换面，无疑将进一步壮大这一趋势。

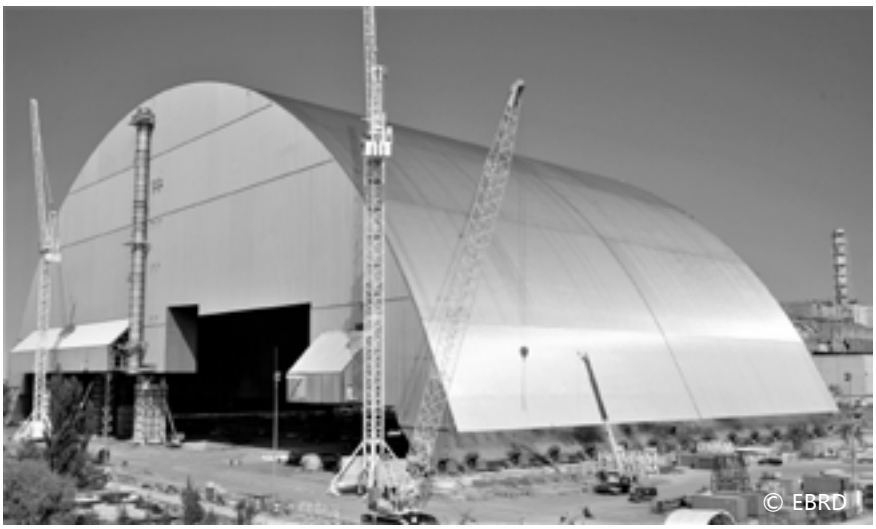
“这个太阳能项目一旦建成，切尔诺贝利将重新焕发生机，再次吸引全球关注。”中国成套工程有限公司和协鑫集成公司 11 月份在一份宣布修建切尔诺贝利太阳能电场的公告中如是说。

乌克兰表示，中国企业准备为该项目投资超过 10 亿美元。

核灾禁区重见天日

随着核事故区太阳能电站建设计划的宣布，一座令人期待已久的拱形钢结构保护罩在核电厂的主体设施旧址上搭建起来。

这个醒目的巨型保护罩于 2016 年 11 月投入使用，将保护周边区域在可预见的将来免受进一步的辐射污染。在欧洲复兴开发银行的资助下，防护罩将于今年晚些时候完工，



这个醒目的巨型保护罩，将保护周边区域在可预见的未来免受进一步的辐射污染

其强度足以抵抗龙卷风的袭击，高度足以容下伦敦的圣保罗大教堂。

乌克兰生态和自然资源部长奥斯塔普·塞梅拉克指出，该设施将把隔离区变成了安全地带。2016 年 12 月，他在谈到电站建设计划时表示：“我们的目标是让切尔诺贝利彻底走出事故和隔离的阴影，进入全新的发展阶段。”

截至目前，核事故周边区域仍然被官方列为人类禁区。在这里作业的工人们需要遵守严格的规定，如穿着防护衣、滞留时间受到限制等。然而，野生动物已经占据了 1800 平方英里的禁区，其中还包括一些濒危和珍稀物种。科学家们正在就辐射对动物的影响进行研究。与此同时，有约 200 人无视持续的放射危险，已经回到他们废弃的家园。

方兴未艾的全球趋势

就在切尔诺贝利 30 公里外的白俄罗斯布拉金，另一座太阳能电站近日开始运行，它同样坐落在 1986 年核事故的污染地带。这座 2.2 万千瓦的电场由中国东方日升新能源股份有限公司承建，利用的是放射性污染最严重的地块之一。

利用太阳能和风能开发毒地等边缘土地已经是一个全球性的趋势，尤其是在土地资源争夺愈演愈烈的当下，很多国家正在努力提高土地利用效率。

在欧洲，推动该趋势的一个关键因素是人们希望借此避免占用农用耕地来发展可再生能源，同时尽可能地扩大可再生能源生产。

根据 2016 年 1 月的一份欧盟太阳能潜力政策评估报告，欧盟正在制订一份太阳能发电系统适宜性地图。在该地图中，受重金属污染的土地被列为建设太阳能电场的优先选择地点。欧盟也在制订诸如责任转移等其他政策，以确保此类土地被转化为低碳基础设施项目。

所谓“责任转移”是一项协议，在该协议下环境风险（无论已知，还是未知；无论过去，现在，还是将来）可以从一个法律实体转移到另一个。该协议经常被用于危险地块的环境修复，当另一个实体接手时，前一家企业就可以免除环境义务。

美国有多个不同规模的此类项目业已完成或正在进行。垃圾填埋场已经成为颇受青睐的太阳能电场选址所在地，各城镇纷纷与太阳能开发商签署再开发协议，通过租赁垃圾场获得租金。

其中一个创新性项目就是在佛蒙特州拉特兰德老填埋场上兴建的 2300 千瓦太阳能电场。该电场与一套 4000 千瓦的蓄电池储电系统一道，为周边地区提供了一个迷你电网。

美国国家环保局已经开发出一个智能地图，人们可以通过它对可以发展可再生能源的污染地点进行初筛。不管是污染区域还是未利用的房顶，任何人都能够下载地图，以验证一个地点是够适合建设太阳能或风能电场。另一个被称为“收益矩阵”的工具可以对潜在选址的经济和环境收益进行快速评估。

切尔诺贝利再度引发关注

据乌克兰政府说，利用切尔诺贝利核电厂的被污染土地进行太阳能发电的提议已经引起全世界投资者的关注。人们对利用此类土地生产清洁能源的整体兴趣也有可能因此而得到提升。

乌克兰政府表示，一大群来自全球的投资者争先恐后地想从切尔诺贝利太阳能项目中分一杯羹，上述两家中国企业只是其中的一部分。塞梅拉克部长在最近的一份声明中说，来自全世界的约 40 家公司表达了对该项目的兴趣，有 10 家公司派出了工程师对该项目的装机容量展开详细研究。

乌克兰注意到，除了中国企业，美国、德国和丹麦公司对这个引人瞩目的项目也有兴趣。塞梅拉克说，这将对其他“潜在外国投资者发出积极信号”。

乌克兰国会于 2016 年 7 月通过了一部允许此类建设的法律，为切尔诺贝利的太阳能项目铺平了道路。此外，欧洲复兴开发银行与乌克兰各政府机构成立的一个工作组正在加紧厘清项目发展所需的其他技术和设计条件，并对项目的经济可行性和环境影响展开评估。

尽管该项目才刚刚开始，但人们高度期待它能震动全世界污染土地利用的大格局。

回到国内，中国同样在鼓励利用受到破坏或污染的土地发展太阳能和风能发电项目。在中国的头号煤炭大省山西——煤矿采空塌陷区上建起的太阳能电站如今已经投入运行。

珍妮·约翰逊，曾经常驻俄罗斯5年，最近迁到缅因州

A ray of sunshine for contaminated Chernobyl site

Constructing a solar farm at Chernobyl could help pioneer the use of contaminated land for clean energy

□ Jenny Johnson

Chinese investors are backing a large solar farm on the site of the infamous Chernobyl nuclear power plant disaster, in a major boost to the use of contaminated sites around the world for renewable energy projects.

The Chernobyl plant meltdown released 400 times more radioactive material than the atomic bombing of Hiroshima. It scattered radiation across large swathes of Ukraine, Belarus and Russia, where it will linger in the soil for centuries. Over 300,000 people were displaced. But thirty years on from the accident, the Ukraine government is laying the groundwork for a major solar project to be located in the fallout zone.

> “Building solar and wind projects on land contaminated by industrial activities and accidents is a growing trend worldwide.”

Building solar and wind projects on land contaminated by industrial activities and accidents is a growing trend worldwide, supported by many who oppose the use of agricultural and public lands for renewable energy. The proposed 100-megawatt Chernobyl solar project may promote this trend by taking an area associated with environmental and human health devastation and turning it into a large scale producer of clean energy.

“Once completed, Chernobyl will re-catch the global attention as a revived site of solar energy,” China National Complete Engineering Corporation and GCL System Integration Technology said in a November statement announcing their plans to build the Chernobyl solar farm. Ukraine said the Chinese companies are ready to invest over US$1 billion in the project.

Exclusion zone ends

Plans to construct a solar farm in the accident area were announced just as a long-awaited arch-shaped steel structure

was positioned over the main damaged unit of the former nuclear power plant.

The technological marvel was put in place in November and will shield the surrounding area from further radiation contamination for at least 100 years. The 162 metre long shield is due to be completed later this year and at a height of 108 metres is tall enough to house London's St Paul's Cathedral, and strong enough to withstand a tornado.

This will allow the exclusion zone to be transformed into a safe area, according to Ostap Semerak, Ukrainian Minister of Ecology and Natural Resources. "Our goal is to end the era of the exclusion zone and accident and go into the era of a new stage of development," said Semerak, in December, of the plans for a solar facility.

Until now, the area around the disaster site has been officially closed off to people. Workers in the contaminated area must wear protective clothing and limit the amount of time they spend there.

However, the 4,662 square kilometre plot has become inhabited by wild animals, including endangered and rare species. Scientists are studying the impact that radiation is having on the animals. Meanwhile, about 200 people have returned to their abandoned homes in the area despite the danger of radiation.

Growing global trend

Just 30 kilometres away from Chernobyl in Bragin, Belarus, another solar farm recently began operation on land contaminated from the fallout of the 1986 disaster. The 22-megawatt facility delivered by Chinese manufacturer Risen Energy is making use of land that was among the most contaminated with radioactive fallout.

The building of solar energy in the most contaminated areas of the planet underscores a growing global trend to put marginal land to use through solar and wind development, particularly as many countries grapple with optimising land use amid competing needs.

In Europe, the wish to avoid capturing agricultural land for renewable energy projects is a key driver, combined with the goal to maximise sustainable energy production.

The European Union's suitability map for solar power systems is being built to include land contaminated by heavy metals as preferred locations for the installation of solar farms, according to a January 2016 policy assessment of solar power potential in the EU. Other policies, such as liability transfer, are being developed to ensure such land can be turned over to low carbon infrastructure projects.

Liability transfer is an agreement under which environmental risk – known and unknown; past, present and future – can be moved from one legal entity to another. This is often used for environmental remediation of hazardous sites, where a company can walk away from environmental obligations as another entity takes it on.

The United States has multiple projects of various sizes completed and underway. Landfills have become popular siting opportunities for solar farms, with towns forming redevelopment agreements with solar developers, who then make payments over the course of a lease on a site.

One innovative project saw the construction of a 2.3-megawatt solar installation on a former city landfill in Rutland, Vermont, in addition to four megawatts of battery backup, allowing the site to function as a mini grid for the surrounding area.

The US Environmental Protection Agency has developed a mapping tool that performs a preliminary screen of contaminated sites for renewable energy potential. The downloadable tool allows anyone to screen a site – from contaminated areas to underutilised rooftops – for suitability for solar or wind installations. Another tool called a "benefits matrix" allows for a quick assessment of the economic and environmental benefits of potential completed sites.

Interest in Chernobyl

The proposal to use the ultimate contaminated site for solar energy production in place of the failed nuclear energy facility has caught the attention of investors worldwide, according to the Ukrainian government, and has the potential to increase the overall interest in development of such sites for clean energy production.

The Chinese companies are among a host of global investors interested in the solar project at Chernobyl, according to the Ukrainian government. About 40 companies from around the world have expressed interest, with ten having already sent engineers to conduct detailed capacity studies, Minister Semerak said in a recent statement.

Ukraine has noted interest from American, German and Danish companies, in addition to the Chinese companies, in the high profile project. All the interest is "a good signal to potential foreign investors," Semerak said.

Ukraine opened the way for the solar project at the Chernobyl site in a law allowing such construction passed by Parliament in July 2016. Other technical and design provisions needed for developing the solar farm, along with economic feasibility and environmental impact studies, are currently being created in a working group with the European Bank for Reconstruction and Development and various Ukrainian government authorities.

China has also been trying to encourage the use of damaged or contaminated land for solar and wind power projects domestically, with plants now operating in subsidence-hit regions of Shanxi, the country's top coal province.

While the Chernobyl project is still at an early stage, there are high hopes it could pioneer the way for transforming the use of highly contaminated land worldwide.

Jenny Johnson is a journalist who spent 5 years in Russia and recently relocated to Maine.

新任环保署长：美国环境的最大考验

一位处处与环保事业作对的新环保署署长，
也许会令美国人幡然醒悟：环境，真的是需要被保护的。

□ 沈 · 岱波

2011年，我受邀在美国众议院能源和商务委员会的一个关于中国环境监管法规的小组委员会面前进行举证。令人意外的是，这次听证会的主题实际上是一份关于美国能源政策的提案（法律），与中国一点关系都没有。所以，我们当时为什么要讨论中国的监管政策呢？

召开本次听证会的共和党委员会成员认为原因主要有两点：一是中国根本不搞环境监管，所以美国竞争不过中国；二是美国的空气和水源已经非常洁净，不再需要环境保护相关的基础设施了。大家一定对这种环境保护阻碍经济发展的论调并不陌生，但这种说法本身是错误的。这些共和党代表们老调重弹，然而，美国过去50年对环境的保护给出了截然相反的答案：反而是加利福尼亚州和东北部几个积极落实环保政策的地区取得了更快的发展。

遭受打压的环境保护署

尽管美国的环境监管在历史上曾经取得了成功，但目前看来，我们曾攻下的阵地却有可能会失守。

谈起新任环境保护署署长斯科特 · 普瑞特，其最出名的“业绩”恐怕就是在担任俄克拉马州总检察长时，对环护署发起了14项指控了。普瑞特不仅与环境保护署对抗，争取地方政府权利，甚至关闭了自己办公室下属的州环境执法部门。

俄克拉马州面临的环境挑战的确是实实在在的，而且随着科技发展变化，还出现了很多全新的难以预料的环境问题。过去这几年里，俄克拉马州与加利福尼亚州一样成为了地震多发地带，而这里以前并不是这样的。公众普遍认为，这一现象主要应该归结于带有争议的水力压裂技术。准确来说，导致这一现象的原因其实不止是水力压裂法，而是与石油和天然气行业采掘过程中广泛采取的污水处理井有关。诚然，当地政府已经开始对此类作业进行规范，甚至关闭了其中一些矿井。但是尽管州长已经发出了严重的警示，普瑞特却在其提名确认听证会上与参议员伯尼 · 桑德斯进行交流时，对这个问题仅仅轻描淡写。

普瑞特并没有努力保护自己的州免受上述新环境问题的威胁。恰恰相反，他几乎对环境保护署的每一项工作都提出了质疑。在他提出的14项针对环保署的指控中，有7项是关于传统空气污染物监管的，6项是关于气候变化监管的，还有一项针对的则是清洁水资源条例。这14项指控基本涵盖了该州所有的能源领域。此外，普瑞特甚至还因为臭氧污染问题对环境保护署提起诉讼。可是，全美25个臭氧污染最严重的城市中，俄克拉马州最大的两座城市就名列其中。

对于普瑞特担任环境保护署新任署长，大部分民众关注的是他对气候变化的态度。鉴于他曾经咄咄逼人地对奥巴马总统的《清洁电力法案》

> 关于中国和印度空气污染的报道通常都被看作发生在国外的故事。殊不知，上世纪50年代的伦敦和纽约，还有上世纪70年代的洛杉矶其实都曾有过类似的遭遇。

发起诉讼，与大多数共和党人一样不支持采取气候行动，并且任命著名的气候变化否认论者麦伦·伊波尔领导特朗普政府的能源与气候转型团队，人们的这些担忧并非是空穴来风。在其提名确认听证会上，普瑞特对参议院议员桑德斯表示，二氧化碳只是"影响了"地球气候，而不是导致气候变化的主要原因。人们主要担心的并不是美国会如伊波尔所愿那样全盘否定气候变化，而是担心环保署会被一系列密集的法律手段捆住手脚。比如普瑞特就曾表示，《清洁空气法》令政府无法为需要减排的电厂提供总量控制和交易方案。而他的替代计划则坚持认为，唯一能够补救燃煤电厂负面影响的方式就是逐个提升燃煤电厂的能效。但这种方式并不能满足挽救气候所需要的减排需求。

在特朗普任期内，美国恐怕很难在应对气候变化方面取得太多进展。事实上，早在特朗普上任之前，美国的气候进程就遭到来自法庭的挑战，其中首当其冲的就是《清洁电力法案》。但是公众对于气候变化的关注度一直很高，因而美国可能至少仍会在国际环境协定中保持一定的存在感。虽然特朗普内阁新任国务卿雷克斯·蒂勒森个人从未对气候行动表示过支持，但是他已经公开表示，将确保美国在这一事务上"占有一席之地"。人们普遍将此解读为对国际气候进程的一种温和支持。

除联邦政策外，受天然气和可再生能源产量增加、煤炭行业持续萎缩、以及能源需求变化等因素影响，美国温室气体排放量已经下降到了25年以来的最低水平，与2007年的峰值水平相比，下降幅度达12%，而且这种趋势还会持续。因此，随着这些宏观经济因素不断推动美国经济碳足迹的下降，很有可能政府会采取顺势无为而治的态度。在这种状况下，减排速度会有多快？答案就是，虽然这个速度无法让我们避免灾难性的气候变化，但温室气体排放下降的大趋势不会变。

逐渐淡漠的公众环保意识

相比温室气体问题，其他污染的状况可能更糟糕。首先，虽然对气候变化的公众讨论一直都很热烈，但是大多数美国人早已记不起曾经的空气和水污染有多严重了。关于中国和印度空气污染的报道通常都被看作发生在国外的故事。殊不知，上世纪50年代的伦敦和纽约，还有上世纪70年代的洛杉矶其实都曾有过类似的遭遇。估计正是通过网飞公司热播剧《王冠》，许多美国人才第一次了解到1952年发生在英国女王伊丽莎白二世早期的那场伦敦大雾霾。这部剧的开篇向观众展示了如当今北京一样糟糕的空气状况。在剧中，气象学家还谈到了1948年发生在美国宾夕法尼亚州的多诺拉烟雾事件。该事件共造成20人死亡，并成为有史以来第一个被记录在案的致命烟雾污染事件。多诺拉市还专门建立了一座烟雾博物馆以纪念此事，不过知道这座博物馆的人很少。很多美国人都不知道，正是1.5万名环境保护署工作人员不懈的努力，才确保了空气和水污染监管法律得到落实，并加深了我们对于国家安全的科学理解。

风险在于，如果公众对环保署的工作没有充分的认识，那么普瑞特就可以相对轻松地将其弱化。这不是没有发生过。安妮·戈萨奇·伯福德是罗纳德·里根总统任期内的首位环境保护署署长。（说也怪，此人恰好也是特朗普提名的美国最高法院大法官的母亲）。伯福德（Burford）曾经将环境保护署的预算削减了45%，导致该机构在环境执法过程中"捉襟见肘"。她把环境保护署的监管方式由强制执行变成了自愿遵守，同时还放松了一系列监管，尤其是对有毒物质的监管。

上世纪80年代早期，人们对空气与水污染的蔓延还记忆犹新。《清洁空气法案》和《清洁水法案》分别在1970年和1972年得到通过。而直到拉夫运河事件爆出之后，有

毒物质的风险才逐渐开始为人们所知。1978 年，拉夫运河社区的人们发现，在他们的家的下面竟然埋着有毒废弃物。人们这才意识到，在美国其他地方同样也存在不少类似的废弃工业废料堆放点。伯福德在任仅仅两年，随后便被国会罢免。

如今的风险在于，公众的环保意识已经没有那么强烈，再加上总统和国会又同属一个政党阵营，普瑞特行事作风可能会比伯福德更加大胆。削减预算可能会捆住环境保护署的手脚，但是也有说法认为，普瑞特可能会直接撤销环境保护署的执法部门，重演当年在俄克拉马州的戏码。环境保护署的执法权力一直让其他国家的环保机构羡慕不已，因为它不仅能够提起刑事诉讼和民事诉讼，还可以对违法者进行调查。除了对污染方进行处罚，该部门执法机构对环境保护署最成功的项目之一，1990 年开始的二氧化硫总量限制与交易制度的成败，也至关重要。这类制度成功的关键在于买卖双方明确了解每笔交易中的排放量。精准的测量是核心，而这必须要通过环境保护署的严格执法才能实现。

州政府环境执法自由有多大?

虽然普瑞特和绝大多数掌权的共和党议员都强调“州的权力”，但也有人担心，普瑞特可能只会给予各州放松环保执法的自由度，而不会鼓励它们加强执法。这个问题不仅对加利福尼亚州来说很重要，对东、西海岸其他各州也同样如此。但加州面临的危险最大，因为该州的空气质量监管一直就比美国其他地区更为严格。作为美国面积最大、人口最多的州，加利福尼亚州的人均机动车保有量也排名全美第一，再加上该地区的气候与地理条件也颇具挑战性，这就导致加利福尼亚州的空气污染治理难度很大。尽管采取了相对严格的空气质量监管措施，但是加利福尼亚州仍然是全美空气质量最差的几个州之一。

一般来说，美国政府在全国采用的是统一的监管标准，以便于业界遵守。比如，如果一辆车能在一个州销售，那在其他州也可以。但是，加利福尼亚州是个例外，因为这里除了其他一些本州特有的规章制度之外，还制定了专有的机动车、燃油质量标准。为了这些额外规定，加州需要年复一年向环境保护署申请豁免。很多人担心加州可能会失去这个豁免，因为 2008 年布什政府任期最后一年时这种事情就发生过。对于加利福尼亚州来说，这关乎他们所有的空气质量监管政策，而对美国东西部其他各州来说，岌岌可危的则是他们的气候变化监管政策。上述这些地区无论是环境目标、还是监管面，都比美国联邦政府更加严格。

水污染：是危机也是契机

美国人或许已经忘了他们的健康和福祉是如何受益于环境保护署的监管的，但是至少有一点还能继续得到公众的关注，那就是水质问题。发生在密歇根州弗林特的铅污染事故已经成为全国性的丑闻。虽然已经有媒体进行了报道，但是绝大多数公众其实并不清楚，还有很多地方同样也面临类似的污染危机。此外，美国政府会计办公室发现，高达 15% 的地区没有资源来应对此类污染问题。最根本的问题在于缺少资金，尤其是那些随着美国人口结构变化而人口日渐减少的地区。

普瑞特供职于俄克拉马州时，曾推迟了清洁水质条例的落实，并针对新的法规对联邦政府提起诉讼。这样的做法会让许多民众陷入危险之中。但是，水危机也是最能引发民众的愤怒，激发民众抵制普瑞特政策的事件。弗林特水质危机引发了全美各地的高度关注，而目前在立岩进行的反石油管道建设示威同样出于人们对地下水污染的关切。若再次爆发水质危机，人们的反对情绪很有可能会加重，从而终止特朗普和普瑞特的削弱监管的计划。然而，以普瑞特手上拥有的权力，不管是削减预算和还是减少执法投入，人们首先迎来的恐怕还是环境破坏。

沈·岱波，在美国加州大学圣地亚哥分校研究环境治理，主要关注中国和印度的空气污染管制

Will clean air and water survive EPA's Scott Pruitt?

People have forgotten how bad pollution was before the EPA. Pruitt may soon remind them

□ Deborah Seligsohn

Back in 2011, I testified in front of a subcommittee of the House Energy and Commerce Committee on Chinese environmental regulation. Surprisingly, the actual subject of the hearing was a proposed bill (i.e. law) on US energy policy that had nothing to do with China at all. So why were we discussing Chinese regulation?

The Republican committee members that called the hearing essentially had two arguments: first, that China didn't regulate the environment and this put the US at a competitive disadvantage, and second, that US air and water were already clean so the country no longer needed the infrastructure of environmental protection.

The argument that environmental protection is somehow inimical to economic growth will be familiar to many readers. It's also wrong. These representatives were rehashing this old argument even though fifty years of environmental protection in the US has shown the opposite: states that rigorously pursue environmental protection, such as California and those in the northeast, actually grow faster.

As Attorney General of Oklahoma, Scott Pruitt closed down the environmental enforcement division of his own office and filed 14 lawsuits against the EPA

A diminished EPA

Despite the historic success of US environmental regulation, we now run the risk of losing substantial ground.

The new Environmental Protection Agency (EPA) administrator Scott Pruitt is most famous for filing 14 lawsuits against the EPA as Oklahoma attorney general. While fighting the EPA and arguing for states rights, Pruitt actually closed down the environmental enforcement division of his own office.

Oklahoma faces real environmental challenges, and moreover, demonstrates that new and unpredictable environmental problems arise as technologies change. In the last few years, Oklahoma has become as earthquake prone as California, despite not previously being associated with earthquakes. While these are blamed in the public mind on the controversial drilling technique called fracking, more accurately they are connected to wastewater disposal wells used by the oil and gas industry for most types of drilling, not just fracking. Indeed the state has begun to regulate and even close some of these wells. But while the state's governor has expressed considerable alarm, Pruitt showed only the mildest concern about this situation in an exchange with Senator Bernie Sanders at his confirmation hearing.

Pruitt was not involved in trying to protect his state from these new threats. Instead, he challenged the EPA in virtually every facet of its work. His 14 lawsuits against the EPA included seven challenging the regulation of traditional air pollutants, six regarding climate change regulation, and one against the clean water rule. All 14 took up concerns of the state's energy sector. Moreover, Pruitt even sued the EPA's rules on ozone pollution, when both of his state's two largest cities rank among the 25 worst cities in the nation for ozone pollution.

Much of the public discussion regarding Pruitt as EPA administrator has focused on climate change, given both his aggressive lawsuits against President Obama's Clean Power Plan, the general opposition of Republican politicians to climate action, and the appointment of well-known climate denier Myron Ebell to head Trump's energy and environment transition team. The concerns are warranted. In his exchange with Senator Sanders at his confirmation hearing, Pruitt would only say that CO_2 "impacts" the climate, not that it is the main cause of climate change. The main issue will not be out-and-out denial of climate change as favoured by Ebell, but an intensely legalistic approach that attempts to tie the EPA's hands. Pruitt has argued, for example, that the Clean Air Act does not allow the government to provide cap and trade options for power plants needing to reduce climate gases. His alternative plan maintains that the only possible remedy for coal-fired power plants is plant-specific efficiency improvements. This approach would hardly yield the needed reductions.

It is unlikely that we will see much progress on climate change during the Trump administration. Indeed, progress was imperilled before Trump came into office from court challenges, especially to the Clean Power Plan. But public attention on climate change is high, and it seems likely the US will maintain at least some presence in international agreements. Trump's new Secretary of State Rex Tillerson, with no history of support for climate action, has nevertheless said that he wants to ensure the US has "a seat at the table," which is generally interpreted as mild support for engagement in the international process.

At the same time, forces well outside of federal policy, including the growth of natural gas and renewable energy production, the continued decline of the coal industry, and shifts in demand, have US greenhouse gas emissions to a 25 year low, down 12% from their 2007 peak. These trends are likely to continue. Thus, while we cannot be certain, it is quite possible that we will see inaction as these larger economic forces continue to drive a lower carbon footprint for the US. Will it be fast enough? Not to avert catastrophic climate change, but it seems unlikely the direction of emissions will change.

Limited public awareness

The situation for other types of pollution may actually be worse. Firstly, while there is much public discussion of climate change, most Americans have long forgotten what serious air and water pollution are like. Reports about air pollution in China and India are generally treated as something that happens only in foreign countries, instead of as something experienced in cities like London and New

> states that rigorously pursue environmental protection, such as California and those in the northeast, actually grow faster.

York through the 1950s and in Los Angeles all the way until the 1970s. Indeed, the popular new Netflix show "The Crown" about the early years of Britain's Queen Elizabeth II may be the first time most Americans ever heard of the great London Fog in 1952, which was really smog. Early in that programme, which shows conditions as poor as any "airpocalypse" in Beijing, the meteorologists talk about another famous smog in Donora, Pennsylvania, in 1948, which killed 20 people, the first such recorded incident. Today, Donora even hosts a Smog Museum, but few Americans have ever heard of it. Americans are unaware of the 15,000 EPA employees who work tirelessly to enforce the laws on air and water pollution and to continue to develop the scientific understanding of what is needed to keep the country safe.

The risk is that with little public awareness, it will be relatively easy for Pruitt to weaken the agency. It has happened before. President Ronald Reagan's first EPA administrator was Anne Gorsuch Burford (oddly enough the mother of President Trump's nominee to fill the vacancy on the US Supreme Court). Burford cut the EPA's budget by 45%, leaving the agency with few resources to enforce environmental regulations. She shifted the agency's focus from mandatory to voluntary compliance, and she relaxed a number of regulations, most notably on toxic substances.

At that time in the early 1980s, the memory of widespread air and water pollution was still fresh. The Clean Air Act was passed only in 1970 and the Clean Water Act in 1972. The risk of toxic substances was just becoming understood, too, following the 1978 discovery of toxic waste buried in a community called Love Canal. It was realised subsequently that there were similar abandoned industrial waste sites all across the United States. Burford lasted only two years in office and was censured by Congress.

The risk today is that with much lower awareness and a President and Congress from the same party, Pruitt could be even bolder than Burford. Cutting the EPA budget would hobble the agency, but there is also talk that Pruitt may eliminate the EPA's Enforcement Division, mirroring his actions in Oklahoma. The EPA's enforcement powers are often the envy of environmental agencies elsewhere in the world. It is able to bring both criminal and civil cases and is known for effectively going after violators. Moreover, in addition to punishing polluters, enforcement is critical to one of the EPA's most successful and cost effective programs, the sulfur dioxide (SO2) cap-and-trade system, first established in 1990. The key to a successful cap-and-trade system is that buyers and sellers know exactly how much emissions are in each deal. Accurate measurement is critical, an aspect the EPA ensures by strict enforcement.

Will states have flexibility?

While Pruitt's language and that of most Republicans is of "states rights", there is also concern that he will only be willing to allow states flexibility if they want less stringent enforcement rather than more. This is a major issue, especially for California, but also for other west and east coast states. California faces the greatest risk because it has always had stricter air quality regulations than the rest of the nation. As the country's largest and most populous state, with the highest number of vehicles per capita, and challenging weather and geographic conditions, California's air quality conditions are difficult to fix. Despite its stricter air quality rules, California still struggles with some of the poorest air quality in the nation.

In general, the US government enforces uniform standards across the country to make compliance easier

for business. If you can sell a car in one state, for example, you can sell it in another. California is an exception, with separate vehicle and fuel quality standards, among other state-specific regulations. California gains this right through an annual waiver from the EPA, and a major concern is whether the state will lose the waiver, as it did once in 2008 during the last year of the Bush administration. For California, the risk is the full range of air quality regulations whereas for other east and west coast states it is to their climate change regulations, with both regions having more ambitious and comprehensive programs than the federal government.

Will water pollution constrain Pruitt?

Americans may have lost track of how their health and wellbeing benefits from EPA regulation but one area where the public continues to have at least some concerns is clean water. The lead contamination in Flint, Michigan has become a national scandal, but despite some coverage in the media most of the public is unaware that many other localities face similar problems. Moreover, the Government Accounting Office has found that as many as 15% of localities lack the resources to address such challenges. The fundamental issue is lack of funds, particularly in areas where population is declining as America's demographics change.

In Oklahoma, Pruitt delayed the implementation of clean water rules and sued the federal government against new regulations. Such approaches will leave many communities at risk. Yet there is no issue that is more likely to engender public anger and the type of opposition that might oppose Pruitt's agenda. Not only has there been considerable national and local attention on the Flint water crisis, but the current protests at Standing Rock, opposing an oil pipeline, are based on concern about underground water contamination. Further water crises may generate sufficient opposition to halt the deregulatory agenda that Trump and Pruitt have intimated. However, given the tools at Pruitt's disposal, both in cutting budgets and in reducing investment in enforcement, considerable damage may well occur first.

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特朗普的煤炭复兴计划将被经济现实打败

特朗普的煤炭振兴计划不会创造就业，反而会为美国带来经济、政治和安全风险。

□ 夏·洛婷

去年5月在北达科他州俾斯麦的一次油气行业会议上，当时的总统候选人特朗普曾表示，化石燃料将会迎来一个光明的未来。

“我们的天然气储量比俄国、伊朗、卡塔尔和沙特加起来还多，煤炭储量是俄罗斯的3倍，我们尚未开发的油气储量估计价值约50万亿美元。想想吧，咱们有的是资源！可是之前我们却没有意识到这一点！”他如此煽动着与会人士的情绪。

但是，特朗普对煤炭的乐观情绪从经济的角度来说不过是镜花水月。这位房地产开发商出身的总统承诺要通过废除奥巴马政府制定的限制煤炭产业的法规来创造就业岗位，而现实则是全球市场决定了这几乎不可能实现。

想想吧，咱们有的是资源！

美国的煤炭企业正在陆续倒闭。世界最大的私有煤炭厂商皮博迪能源2016年 申请破产，而近年来倒闭的美国煤炭企业已经达到50个。

美国煤炭产业每年失去约1万个工作岗位，这不是因为缺少土地或采矿权，而是因为这个行业已经不再有利可图。

根据美国能源部的数据，风能和太阳能产业如今为美国提供了比化石燃料部门更多的就业机会。在全球范围内，2016年可再生能源是新增装机容量最大的能源形式。

根据美国能源部最近公布的一份报告，煤炭产业挖掘、开采、发电等环节的就业人数约为16万人。但是，2006年以来煤炭发电量已经下降53%。这一趋势还将继续，而煤电衰退导致的失业只能依赖天然气和可再生能源就业的增长来挽救。2016年太阳能产业就业人数达到约37.4万人，同比增长了25%；同年风能产业就业人数为10.2万人，增长了32%。

人事任命透露特朗普环境议程

特朗普本月的内阁任命表明，发展绿色经济并不是新政府的工作重点。相反，新政府将进一步鼓励页岩油气和煤炭扩张，并取消对化石燃料的生产限制。

特朗普任命了有“石油代言人”之称的前埃克森美孚总裁雷克斯·蒂勒森担任国务卿。埃克森美孚此时已深陷调查：该公司被怀疑从70年代开始隐瞒有关化石燃料对气候影响，并且资助某些组织来抵制气候变化真实存在的这一科学共识。

而直言不讳自己是“气候变化怀疑论者”的斯科特·普瑞特被任命为美国环保署署长，此人职业生涯中有不少时间都在与环保署为敌。得克萨斯州前州长里克·佩里被任命为能源部部长也让不少人大跌眼镜，因为他曾在2011年声称只要有机会就会“ 取消这个部门”。

这些颇具争议的人事任命传达出的信号是，特朗普将会想办法束缚美国环保署的手脚，并且推翻过去8年中奥巴马制定的环境法律。

多条环保法案或被撤销

特朗普已经威胁说要“取消”限制全球变暖的巴黎协定，该协定不久前被近200个国家以创纪录的速度签署并通过。他还威胁要撕毁美国的《清洁电力计划》，一个减少发电厂二氧化碳污染的历史性计划。

此外，他还计划取消一系列法规，例如关于联邦煤矿用地租赁的禁令，以及遏制油气部门甲烷排放和禁止采煤企业从事污染饮用水的生产活动等的法规。

新政府或加剧气候变化威胁

那么，特朗普政府对气候行动的威胁到底有多大呢？

世界资源研究所气候项目全球主管葆拉·卡巴勒罗说：“2007年以来，美国一次能源消费减少了2.4%，而经济增长了10%。我们希望美国在全球清洁能源转型中能够保持这一势头。背弃过去的承诺，很有可能使美国受到政治和经济的双重孤立，并且失去近年来已经得到公认的全球领导地位。”

新一届政府对气候变化带来的安全威胁没有足够的认识，这让华盛顿的军事和安全专家们感到忧虑。

“气候变化是一个需要我们从国家安全角度来解决的主要问题。”国家安全问题研究机构“美国安全计划”的CEO斯蒂芬·切尼准将如是说。

切尼说：“从任命听证会的情况来看，蒂勒森的确不无道理，但在我看来还不够有说服力。一些回应还有点令人不安。”他指的是雷克斯·蒂勒森拒绝承认气候变化是一个迫在眉睫的国家安全威胁。

他还说：“我对雷克斯·蒂勒森被任命为国务卿深感忧虑。”

另外一些人则认为气候变化将打乱国际政局，代表人物之一就是被特朗普任命为国防部长的“疯狗”马蒂斯将军。

本周早些时候，马蒂斯称他认为气候变化会导致北冰洋出现多条新航道。他还建议美国必须保护自身在该地区的利益，并说国防部应该减少对化石燃料的依赖。他潜在的忧虑就是气候变化可能导致气候难民增加，从而增加冲突的风险。

化石能源无法提振美国经济

如果美国不履行在国际上做出的抗击气候变化的承诺，将会被欧洲的贸易伙伴们嗤之以鼻。

英国前能源与气候变化大臣爱德华·戴维说：“抗击气候变化的全球经济转型已经成形，不可逆转。如果哪个国家不参与进来，就会在创新竞赛和新技术的创造中落后，这一点已经越来越清晰。”

与此同时，中国已经决心成为“清洁电力时代”的领导者，并且已经在清洁技术推广和全球融资方面扮演了领头羊的角色。能源经济与金融分析研究所最近的一份报告表明，中国去年在海外可再生能源及相关技术上的投资高达320亿美元（2200亿元人民币），同比增长60%。

如果美国在气候问题上倒退，可再生能源投资将流向他处。而印度和中国已经做好了开放其绿色金融市场的准备。

可再生能源技术的投资势头正高涨，但特朗普政府很有可能把纳税人的钱浪费在化石燃料补贴上，同时拖住美国经济去碳化行动的后腿。这与特朗普增加高薪就业和帮助商界扩大出口的计划是背道而驰的。

夏·洛婷是一名驻伦敦记者，关注中国及环境问题

Economic realities will override Trump's coal plan

Trump's promise to invest in coal won't bring back US jobs

□ Charlotte Middlehurst

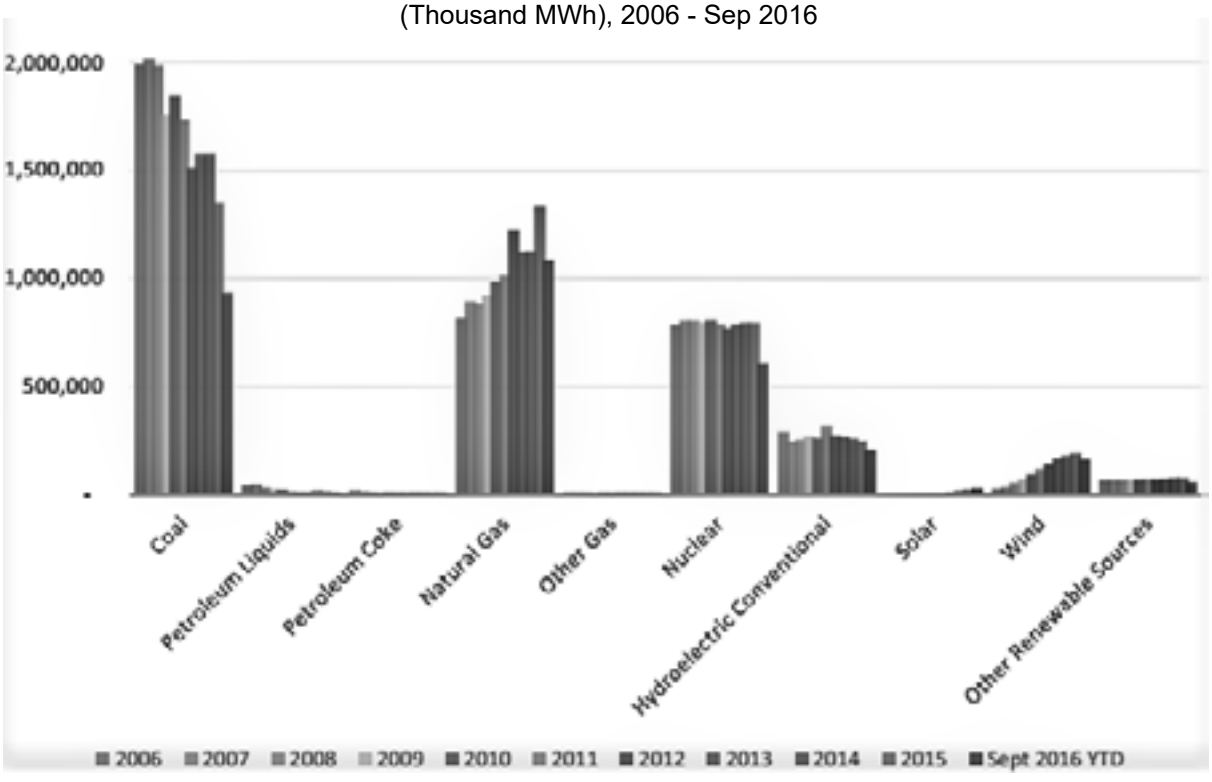
At a coal and gas conference in Bismarck, North Dakota, in May, US President-elect Trump hinted at a bright future for fossil fuels.

"We have more natural gas than Russia, Iran, Qatar and Saudi Arabia combined. We have three times more coal than Russia. Our total untapped oil and gas reserves on federal lands equal an estimated US$50 trillion. Think of that. We're loaded. We didn't even know it. We're loaded!" he told an excitable industry crowd.

But Trump's bullish tone on coal belies an economic

Change in power generation by energy source in the US

(Thousand MWh), 2006 - Sep 2016



Data source: US Department of Energy

fiction. While the property developer-turned-president has promised to deliver new jobs by ridding the coal industry of the restrictive regulations introduced by the Obama administration, the reality is that global market forces make this almost impossible.

Coal utilities are closing down in America. Peabody Energy, the world's largest privately owned coal producer, filed for bankruptcy in 2016, becoming the 50th US coal producer to do so in recent years.

The sector is losing around 10,000 jobs per year in the US. And not because it lacks the land or permits to grow but because it is no longer profitable to do so.

Wind and solar now support more jobs in the US than fossil fuels, according to data from the Department of Energy. And globally, renewable power was the largest source of newly installed energy capacity in 2016.

According to a new report released by the US Department of Energy, the coal sector employs about 160,000 people in mining, extraction and generation. However, generation from coal has declined 53% since 2006. This will continue, with the loss of jobs being offset by growth in natural gas and renewables. The solar sector employs just under 374,000 people and increased by 25% in 2016. Similarly, wind employs 102,000 people and increased by 32% in 2016.

The agenda

Trump's cabinet appointments, which are taking place this month, indicate that the green economy is a low priority for the new administration whereas encouraging further shale and coal expansion and cancelling restrictions on production are high on the agenda.

The appointment of new secretary of state Rex Tillerson, a former general manager of ExxonMobil oft described as "big oil personified", comes amid a season of disgrace for Exxon, which is under investigation for hiding knowledge dating back to the 70s on the impact of burning fossil fuels on the climate, while funding organisations to counter the scientific consensus that climate change is real.

"Climate denier" Scott Pruitt, has been nominated new head of the Environmental Protection Agency (EPA), an institution which he has devoted part of his career to dismantling. Meanwhile, the appointment of former Texas governor Rick Perry to head the Department of Energy has raised eyebrows given his declaration in 2011 that he would abolish the department given the opportunity.

These controversial appointments signal that Trump is seeking to hobble the EPA and roll-back environmental legislation introduced by Obama over the past eight years.

On the chopping block

Trump has threatened to "cancel" the Paris Agreement to limit global warming, which was signed by almost 200 countries and ratified at record speed in 2016; and to tear up the Clean Power Plan, a historic step in reducing carbon pollution from power plants.

Also on the chopping block is the removal of a ban on coal leasing on federal lands, and regulations to curb methane emissions from the oil and gas sector and prohibit coal-mining companies from engaging in activities that pollute drinking water.

The risk

So how big a risk is the Trump administration to climate action?

"Since 2007 primary energy consumption has fallen by 2.4% while economic growth has increased by 10%. We will be looking to the US to continue the forward momentum on the transition towards clean energy globally. Moving away from that commitment would risk isolating the US politically and economically, and losing that global leadership which has been the hallmark of the US in recent times," said Paula Caballero, global director of the Climate Program at the World Resources Institute.

In Washington, military and security experts are concerned by the lack of recognition of climate change as a security threat.

"Climate change is the primary issue that we need to

tackle from a national security perspective," said Brigadier General Stephen Cheney, CEO of the American Security Project, a research organisation dedicated to national security issues.

"When you look at the confirmation hearings there were some questions on it but not enough in my opinion. And some of the responses are a bit troubling," said Cheney, referring to Rex Tillerson's refusal to recognise climate change as an imminent security threat.

"I am deeply concerned by Rex Tillerson's appointment as secretary of state," he added.

However, others such as General "Mad Dog" Mattis, have recognised climate change as a driver of political instability.

Earlier this week, Mattis noted that he sees climate change opening up sea lanes in the Arctic. He also suggested that the US needs to protect its interests in that region, and that the Department of Defense should reduce its dependency on fossil fuels. The underlying concern is that climate change may lead to an increase in climate refugees that in turn will increase the risk of conflict.

Business momentum

Should America step back from its commitment to fight climate change internationally, the news will be greeted sourly by trade partners in Europe.

"We have passed a tipping point in the economy of tackling climate change. It is increasingly clear that countries that do not will be left behind in the innovation race and creation of new technologies," said Edward Davey, former UK Secretary of State for Energy and Climate Change.

Meanwhile, China is poised to become leader of the "clean power age" and has already assumed leadership in deployment of clean technology and global financing. A recent report from the Institute for Energy Economics and Financial Analysis revealed that China invested a record US$32 billion (220 billion yuan) in overseas renewable energy and related technologies last year, marking a 60% year-on-year increase in spending.

If we see the US backing away in one way or another, investment in renewables will go elsewhere. India and China have been opening up their market for green financing in readiness.

Despite the investment momentum in renewable technologies, the Trump government risks wasting taxpayer money on fossil fuel subsidies that could delay US action to decarbonise the economy. And that may not be part of Trump's plan to provide well paid jobs and help business expand their exports.

Charlotte Middlehurst is a London-based journalist with a special focus on China and the environment.

特朗普来了，而美国将继续能源转型

虽然特朗普内阁可能会废除《清洁电力计划》，但是已经走上低碳发展道路的美国各州不会因为新任总统的意愿而停步。

□ 弗雷德里克·韦斯顿

本周五美国将迎来新一届政府，与此同时，关于美国《清洁电力计划》（Clean Power Plan，简称CPP）存留的猜测也甚嚣尘上。当选总统特朗普在竞选期间就明确表达了他对气候变化的看法，他认为所谓的“气候变化”就是中国恶意编造的一场骗局。自胜选以来，特朗普先后提名的几个重要机构的负责人，包括环境保护署和能源部的提名人选，都曾在言语上或实际行动中表达过类似看法。

特朗普的过渡团队已经对能源部的现有工作进行了高调质询，目标直指曾经负责气候变化相关事宜的官员。一切迹象都表明，这位新任美国总统将会停止抵御全球变暖的努力，首当其冲的就是要废除《清洁电力计划》。

但要废除这一法案并不容易。《清洁电力计划》是基于联邦法律而被采纳的，意在应对碳排放对公众健康的威胁（这一结论获美国最高法院的支持）。美国总统无权单方面撤销该计划。因此，虽然《清洁电力计划》可能暂时处于“搁置”状态，也就是说在司法审查阶段该计划暂时无法得到落实，但是支持者们仍然乐观地认为，这项计划最终能够经受住美国最高法院的严格审查。一年前，美国最高法院大法官安东宁·斯卡利亚（Antonin Scalia）去世后，共和党控制的参议院使该席位极具争议地一直处于空缺状态。特朗普提名何人填补这一空缺将会对《清洁电力计划》的存废产生巨大影响。但无论如何，我们都不应该指望新一届美国政府会在法庭上维护《清洁电力计划》，或者说在《计划》得到法院支持后积极落实相关措施。

不出意外，至少在未来4年里《清洁电力计划》将会是一纸空文。而这对美国未来的气候变化相关行动意味着什么？乐观主义者也许会觉得这没那么可怕。原因很简单，因为美国各州层面的努力从未停歇。

州的力量

气候变化本质上是个能源问题，一个如何生产和使用能源的问题。各州政府早就意识到了这一点并引领着清洁能源转型。然而，美国联邦政府从未出台过一个全面、统一的国家能源政策。没错，在过去这些年里，国会在能源方面的政策总是让人捉摸不透，他们既支持核能发展，也支持可再生能源探索，既支持国内化石燃料资源开发，也支持取消对独立电力企业的并网限制。但是，从整个国家层面上来看，国会从未采取实际行动，全面推动能源生产和使用向低成本、低污染的方向改革。

于是各州政府纷纷行动起来。依据美国宪法赋予的权利，这些“民主实验室”在过去40年里所开展的工作弥补了联邦政府在这一方面的不作为。他们认识到，能源使用真正的成本源自对环境的破坏，所以他们将终端能效提升投资变成了不成文的法则，将提高能效作为满足能

如果《清洁电力计划》被推翻，加利福尼亚州、康涅狄格州、马萨诸塞州，以及包括中国和印度在内的多个国家就必须额外承担更多的领导责任

源需求的首要途径。

除此之外，各州政府还制订落实了一系列支持可再生能源发展的项目，目的是使新能源最终能够参与公平市场竞争。这些扶持项目不仅开拓了新的电力市场，也为电力生产所需要的新的服务——如电网系统的灵活性和平衡性——开拓了空间，因为电力还不能被简单而经济地储存起来。在这些项目的扶持下，相关技术领域出现了很多变化：比如小型分布式清洁能源发电从无到有；再比如用户可以自主管理用电需求，既节省费用，还能造福整个电力系统。此外，各州政府还推出了排放权交易等机制，为进入能效提高和可再生能源等项目的投资带来了现金流，以加速减排进程，降低合规成本。据预测，到2030年全美各地这些减排措施累计起来的减排效果将接近《清洁电力计划》所设定的目标。

以上这些创新措施的出台都比《清洁电力计划》要早。因此，无论《清洁电力计划》未来的命运怎样，这些措施仍将推动温室气体排放进一步大幅降低。各州还会继续采取行动，因为公众对这些行动给予了前所未有的支持。比如在2016年就有多个州调高了可再生能源发电占比要求。但也不是所有州都取得了进步，所以我们也不能低估《清洁电力计划》被废除所带来的损失。因为这项计划要求所有各州必须履行减排义务，它的缺席将导致那些本就不愿采取减排行动的州继续保持不作为状态。这样的结果是我们都不愿意看到。《清洁电力计划》是应对紧迫的全球威胁的一个兼顾各方利益的、有创意的途径，不能仅仅因为有人对它不满就将它忽视。

如果《清洁电力计划》被推翻，那么美国在气候变化领域的领导力将受到重创。包括中国、德国和印度在内的多个国家就必须额外承担更多的领导责任。幸运的是，包括加利福尼亚州、康涅狄格州、马萨诸塞州、俄勒冈州、纽约州和佛蒙特州在内的多个美国地方州政府仍将与上述国家一道，为气候保护行动贡献出自己的力量。

弗雷德里克·韦斯顿，现任睿博能源智库(RAP)中国项目主任

States, not Trump, will decide US energy future

The Trump administration may scuttle the Clean Power Plan but states remain committed to a low carbon future

□ Frederick Weston

With the change of administration on Friday, speculation on the future of the US Clean Power Plan (CPP) is running high. During the campaign, the President-elect made his views on climate change – it's a hoax perpetrated by China – perfectly clear. And since the election, he has appointed people to key agencies, the Environmental Protection Agency and the Department of Energy (DOE), who have by word or action expressed similar scepticism.

Trump's transition team has made a very public inquiry into the current work of DOE, targeting for special investigation officials that have been engaged in activities related to climate change. There is every reason, therefore, to conclude that the next president will cease efforts dedicated to mitigating global warming. Foremost among them will be abandonment of the Clean Power Plan.

> "It seems safe, then, to assume that the CPP will become dead paper, for the next four years at least."

It won't necessarily be easy. The CPP is an adopted rule under federal law responding to a finding (upheld by the US Supreme Court) that carbon pollution endangers public health. A president lacks the authority to unilaterally withdraw it. So though it is true that the CPP has been "stayed", meaning its implementation has been delayed pending judicial review, supporters remain optimistic it will survive scrutiny by the Supreme Court.

The likelihood of this may be affected by the new president's appointment of a justice to the ninth seat on the Court, which had been kept controversially vacant by the Republican-controlled Senate since the death of conservative supreme court judge Antonin Scalia a year ago. In any event, we cannot expect the new administration to defend the CPP in court or implement it if it is upheld.

It seems safe, then, to assume that the CPP will become dead paper, for the next four years at least. What does this

mean for US action on climate change? An optimist will say, "Perhaps less than one might fear." The reason for this is simple: the states.

The power of states

Climate change is, at its core, an energy problem, a problem of how we produce and use energy. The states have long recognised this and have led the clean energy revolution. The federal government has never set a comprehensive, coherent national energy policy. Yes, over the years, Congress has acted variously to support nuclear power and some renewable sectors, the exploitation of domestic fossil-fuel resources, and the opening up of the electric grid to independent power producers; but at the national level there has been no real attempt at comprehensive reform to drive energy production and use toward the lowest cost and least environmentally harmful resources.

The states stepped into the breach. Under the powers reserved for them by the US Constitution, these "laboratories of democracy" over the last forty years have filled the void created by federal inaction. They have recognised that environmental damage is a real cost of energy use and therefore made investment in end-use energy efficiency, the law of the land, as the first resource to meet demand for energy services, not the last.

States have developed and implemented programmes for financing renewable technologies, until those technologies are able to compete on fair terms in the market. They have created new markets to provide not only electricity, but also the unique services – flexibility and balancing – that electricity production needs, because kilowatt-hours cannot yet be easily or economically stored. They have seen how technological change has made small-scale, distributed clean energy a reality, and made it possible for consumers to manage their demand in ways that benefit the system and save money.

And they have implemented programmes that put a price on greenhouse gas emissions and create revenue streams for direct investment in clean energy measures, such as end-use efficiency and renewables, to accelerate emissions reduction and drive down the costs of compliance. The cumulative national carbon effects of state actions are already projected to achieve nearly all of what the CPP would require by 2030.

These innovations predated the Clean Power Plan and, whatever its future, they will go on producing significant emissions reductions. The states will continue to act because public support for action is greater now than ever. In 2016, for example, several states increased the required minimum percentage of electricity generated by renewables to be delivered to all customers.

But not all states have made progress, and it would be wrong to underestimate the consequences of the loss of the CPP. It imposes obligations on all states, and its absence will allow those that have been reluctant to act to remain so. This is too bad. The CPP is an inventive and balanced approach to addressing an urgent global threat, which cannot be ignored simply because one wishes it didn't exist.

America's leadership on climate change will suffer if the CPP is overturned. Other nations, most notably China, Germany, and India, will need to take on that extra leadership burden. Fortunately, they will have states – California, Connecticut, Massachusetts, Oregon, New York, and Vermont, to name just a few – to turn to for help and, we hope, inspiration.

Frederick Weston directs the Regulatory Assistance Project's China Program.

中国对拉美投资热度不减

2016年中国总计向拉丁美洲发放了220亿美元贷款，这显示拉美国家的经济困境并未削弱中国的投资热情。

□ 罗伯特·苏塔

中国去年在巴西的大部分投资被巴西国家石油公司获得

尽管面临着迅速增长的国家债务和伙伴国的政治动荡和经济危机，拉丁美洲国家依然从中国获得了稳定的大量投资。美洲国家对话组织和波士顿大学发布的最新报告显示，去年中国国有银行对拉贷款额达到了史上第三高。

中国 – 拉美金融数据库 2016 年最新数据显示，尽管中拉双方都出现经济增速放缓，但去年中国政策性银行仍向拉美提供了约 220 亿美元的贷款，为史上第三高位，仅次于 2015 年的250亿美元和2010年的350亿美元。

2005 年至今，中国在拉美投资总额已经超过 1410 亿美元，成为目前该地区最大的债权国。

“中国资金大部分流向了拉美经济最脆弱的国家。”美洲国家对话组织网站公布的一份报告显示，其中约 92% 流向厄瓜多尔、委内瑞拉和巴西。

去年是巴西饱受困扰的一年，国内经济缩水 3.5%，牵连甚广的腐败丑闻导致政府和在野党多位高官纷纷落马。然而，这一年巴西却获得

了中方 150 亿美元的投资，占中国对拉投资总额的 72%。

与此同时，2016 年中国国债与 GDP 的比值上升至 279%，导致这种情况的一部分原因就是大规模的海外投资。

参与研究报告的波士顿大学教授凯文·盖拉格认为，中国的巨额外汇储备意味着这还不是主要问题。但他也指出，中国在过去 20 个月的时间里已经快速消耗了大量外汇储备。

“他们必须更加关注自身全球投资组合的风险。”盖拉格告诉中拉对话。

对拉贷款热度不减

对于巴西、阿根廷、厄瓜多尔、以及问题重重的委内瑞拉来说，中国是他们少有的投资来源之一，而这些国家也是中国贷款最大的接收者。和往年情况类似，贷款大多集中用于偿还现有债务，或是投入能源部门的发展和基础设施建设。

去年 11 月，中国国家开发银行向中国石油天然气集团公司和委内瑞拉国家石油公司共同成立的合资公司提供了 22 亿美元的贷款，用于刺激石油生产。

国际油价暴跌之后，作为石油输出国组织（OPEC）的一员，委内瑞拉陷入严重的经济衰退，影响了偿还中国债务的能力。而委内瑞拉与中国达成的以油偿债的协议让情况变得更加复杂。

同样处于低谷的厄瓜多尔上周日举行了总统大选。由于执政党候选人莱宁·莫雷诺和右翼前银行家吉列尔莫·拉索均未符合首轮直接胜出的条件，故将于 4 月 3 日举行第二轮大选。但无论谁当选，他们都无意与中国重新协商以油还债的贷款协议。

无条件贷款政策或有变数

报告还表示，与总部设在华盛顿的金融机构贷款不同的是，中国政策性银行贷款依然不对贷款设置条件，如要求债务国采取某些经济政策等。

国际货币基金组织和世界银行的“附加条件”政策曾在上世纪 90 年代到 21 世纪初的拉美引发民众强烈不满，认为这一政策不仅给政府施加了难以应对的债务偿还条件，而且侵犯了各国的自主决策权。

同样，中国专家也在密切监控拉美地区未知的政治经济前景，并认为中拉关系或将迎来“转折点”。

“拉美地区各国应改善自身投资环境以吸引更多中国投资者。”上海大学拉丁美洲研究中心主任江时学最近对中新社表示。

盖拉格说：“为了督促拉美国家偿还贷款，中国越来越多地倚重外交手段。有意思的是，如果有一个国家债务违约了，中国说不准会采用更加直接的手段进行干预。”

玻利维亚或成中资新热点

报告指出，2015 至 2016 年间，玻利维亚得到了“中国政策性银行相当大的关注”。

近年来，中国企业在玻利维亚的存在感大大提高，且高度活跃于能源、交通和矿业部门。2016 年中国进出口银行为埃尔穆通铁石矿和罗西塔斯水电站项目提供资金，并投资了一个价值 5000 万美元的安保项目。该项目的指挥中心位于拉巴斯，视频监控系统将覆盖六座城市。

然而，和厄瓜多尔等其他拉美国家的情况一样，中国在玻投资大部分依旧集中在原料的开采和运输上，很可能会因“资源诅咒”而被套牢。

中国的需求曾导致大宗商品价格连续十年上涨，这让出口国家几乎毫无发展多样化经济的直接动力，只是坐吃山空。如今大宗商品价格暴跌，各大出口国几乎已经没有其他的生财之道。

“拉美各国政府面临的挑战将是，如何才能拿出既能吸引中国合作伙伴，又能确保经济和环境可持续发展的引资计划。”报告指出。

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China's investment splurge in Latin America continues

New data shows 2016 is third highest year for Chinese loans with risky countries the main recipients

□ Robert Soutar

Neither mushrooming debt at home nor political upheavals and economic crises in partner countries stemmed the steady flow of finance from China to Latin America last year – the third highest on record for state-owned bank loans, according to new data from the Inter-American Dialogue and Boston University.

Updated figures for the China-Latin America Finance Database for 2016 show that despite economic slowdowns in both regions, China's policy banks provided some US$22 billion in loans. Last year's lending is surpassed only by the US$25 billion and US$35 billion disbursed in 2015 and 2010, respectively.

Chinese finance to the region now totals over US$141 billion since 2005, making it by far the biggest lender.

"The bulk of Chinese finance was directed to some of Latin America's most fragile economies," says the report announcing the figures. Some 92% went to Ecuador, Venezuela and Brazil.

Brazil received US$15 billion, or 72%, in a year that was beset by an economic contraction of around 3.5% and a wide-ranging corruption scandal that tainted multiple high-level politicians in both government and opposition.

Meanwhile, in China, national debt rose to 279% of GDP in 2016, in part because of large-scale investment overseas.

Boston University's Kevin Gallagher, who co-authored the research, said China's massive currency reserves mean this is not yet a major concern, although he pointed out that the country has "burned through" a lot in the past 20 months.

"They have to be more concerned about the exposure of their global portfolio," Gallagher told *Diálogo Chino*.

More of the same

Brazil, Argentina, Ecuador and embattled Venezuela have few alternative finance sources outside China and they

> "Chinese finance to the region now totals over US$141 billion since 2005."

remain its largest recipients of loans. Much of these are concentrated on servicing existing debt obligations or developing the energy and infrastructure sectors, as has been the trend in previous years.

In November last year, China Development Bank provided US$2.2 billion for a joint venture between China National Petroleum Corporation and Venezuela's state-owned PDVSA to boost oil output.

The OPEC nation has been mired in deep recession since the crash in global oil prices, which has impacted its ability to repay debt to China. This is compounded by an arrangement through which Venezuela pays back the loans with oil.

Ecuador, which is also reeling from the slump, held presidential elections on Sunday but expects no renegotiation of its oil-backed loan deals with China under either Lenin Moreno, the incumbent government's candidate, or Guillermo Lasso, a right-wing former banker. The two will contest a presidential run-off on April 3.

Conditions

The report also says that unlike loans from Washington-based financial institutions, Chinese policy bank loans remain unconditional on adopting certain economic policies.

The IMF and World Bank's "conditionality" polices sparked a popular backlash in Latin America in the 90s and 2000s as they were seen as imposing unmanageable debt repayments on national governments and infringing on their policy-making autonomy.

All the same, experts in China are monitoring the uncertain political and economic outlook in Latin America closely, and sense that a "turning point" in the relationship may be on the horizon.

"Latin American countries and regions are expected to improve their investment environments to attract more Chinese investors," Jiang Shixue, director of the Center for Latin American Studies at Shanghai University, recently told China News Service.

Gallagher said: "China is giving more diplomatic advice to ensure they get their money back. If one of the [recipient] countries defaults it will be interesting to see if they get more explicit."

Bolivia: New partner

Bolivia received "considerable attention from China's policy banks in 2015 and 2016", the report notes.

Chinese companies have significantly increased their presence in Bolivia in recent years and are highly active in the energy and transport infrastructure and mining sectors. The Export-Import Bank of China (China EXIM Bank) released funds for the El Mutún iron ore mine and Rositas hydropower plant in 2016, as well as for a US$50 million security project consisting of a command center in La Paz and video surveillance systems in six cities.

However, as with Ecuador and other regional neighbours, much of China's investment in Bolivia remains focused on the extraction and transportation of raw materials, which carries the threat of locking-in the "resource curse".

Chinese demand caused a near decade-long boom in commodity prices, giving exporting countries little immediate incentive to diversify their economies. But this can turn into dependence. Now prices have crashed, big exporters are left with few other ways of bringing in money.

"The challenge for Latin American governments will be to propose deals that are both attractive to Chinese partners and economically and environmentally sustainable," the report says.

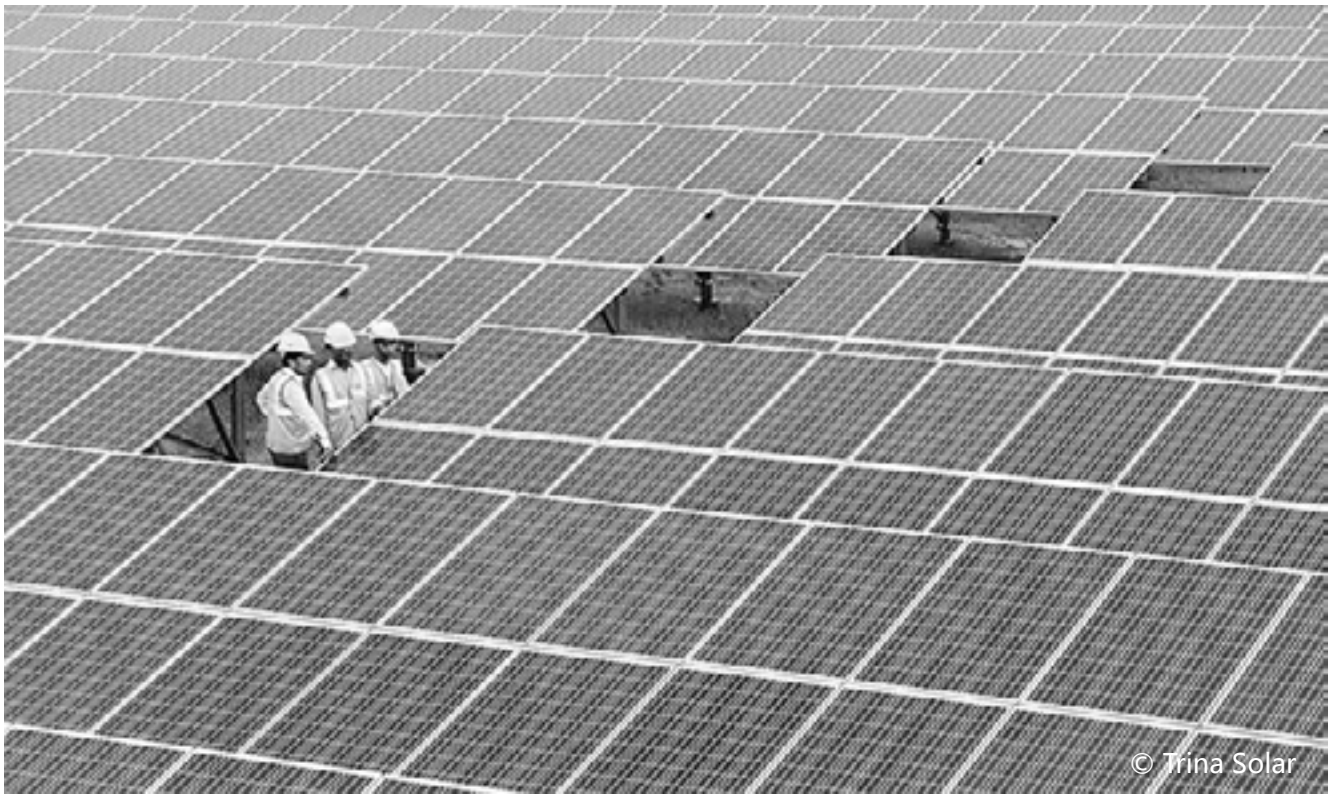
This story originally appeared on Diálogo Chino and it republished here with permission.

Robert Soutar is Managing Editor of Diálogo Chino, based in London.

中国领衔全球清洁能源投资

在美国投资预计将会减少的预测下，中国无疑有望成为全球清洁能源的领导者。

□ 夏·洛婷



中国在清洁能源产业的投资快速增长

最新数据显示，中国公司正准备加大对清洁能源技术领域的国际投资，以填补美国等主要经济体投资缩减所留下的空缺。

能源经济与金融分析研究院（IEEFA）发布的最新报告显示，去年中国在可再生能源及相关技术领域的海外投资同比增长60%，达2200亿人民币，创历史新高。

2015至2021年间，中国新增的风能、太阳能以及水力发电能力大约将占全球三分之一。与此同时，亚洲基础设施投资银行（AIIB）以及中国进出口银行等中方引导的贷款机构也有足够的财力来引领全亚洲电力部门的转型。

中国在清洁能源产业的投资规模和增速都说明，中国已经做好准备成为全球新清洁能源时代的领军者，尤其在美国特朗普政府环境政策存在不确定性的情况下。

“中美两国都想在蓬勃发展的清洁能源市场中占有更大的份额，但在这场竞赛中，美国已经远远落后

于中国。当选总统特朗普大力鼓吹煤炭和天然气行业的发展，这对其国内未来的政策改革而言并不是好兆头，”IEEFA 澳大拉西亚能源金融研究主管蒂姆 · 巴克利在一份申明中说。

“美国如果真的要振兴制造业，就不该放弃清洁能源部门的发展，”巴克利说。

中国的国内可再生能源投资规模已经居世界首位。上周四，中国国家能源局（NEA）宣布，作为国家“十三五”规划的一部分，中国将在2020 年之前投资 2.5 万亿元人民币用于可再生能源发电，推动国内市场逐步放弃高污染的煤电，转而使用更加清洁的能源。

中国“走出去”战略最新阶段的一部分也与国家能源战略相吻合，计划通过“一带一路”倡议，建立一系列横跨亚洲、影响力远及欧洲的贸易及基础设施网络。

这意味着中国将成为给全球带来绿色就业机会最多的国家。国际能源署《2016 年世界能源展望报告》估计，全球 810 万可再生能源工作岗位中有 350 万个来自中国企业。相比之下，美国可再生能源工作岗位仅 76.9 万个。

> 国际能源署《2016年世界能源展望报告》估计，全球810万可再生能源工作岗位中有350万个来自中国企业。相比之下，美国可再生能源工作岗位仅76.9万个。

中国的风能和太阳能投资大部分都流向了美国、德国、意大利、澳大利亚以及南非。而拉丁美洲则是目前可再生能源发展最具吸引力的新兴市场之一，中国企业已在墨西哥、巴西、阿根廷以及智利等拉美国家投入了非常可观的资金。

2016 年，中国最大的锂生产商天齐锂业投入 172 亿人民币，收购全球第四大锂生产商智利化工矿业公司（SQM）少量股权——后者刚刚在 2016 年底退出这桩交易。锂主要用于制造电动汽车的电池。根据 IEEFA 的报告，未来 9 年，全球电池制造业对锂的需求将翻一番。

针对电力传输这一战略领域，中国国家电网（SGCC）去年与巴西电力公司 CPFL Energia SA 就能源、发电、以及电力输配达成了价值 895 亿元人民币的协议。中国资本涌入拉美预计将对该地区的地缘政治造成重大影响，撼动欧美国家几十年来的主导地位。

“中国非常清楚可再生能源领域蕴藏的巨大商机，不仅在国内投入海量资金推动清洁能源转型，更积极寻求扩大海外商机。美国开启了石油时代，而中国正在塑造其在当今清洁能源行业中无可撼动的领军者地位。日后回看这段历史，美国或许将后悔不已。”巴克利说道。

夏 · 洛婷是一名驻伦敦记者，关注中国及环境问题

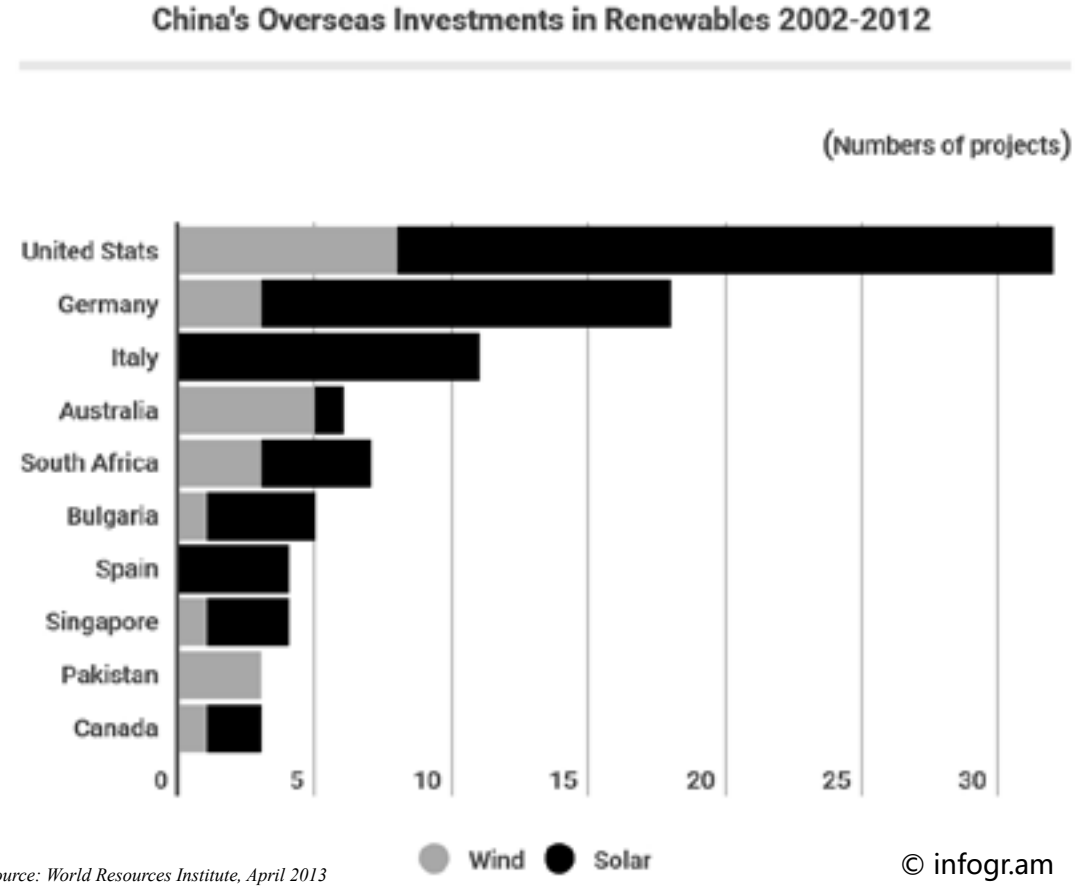
China emerges as global leader in clean energy

With US investment expected to wane, China will become the “unrivalled” leader of the clean power age

□ Charlotte Middlehurst

Chinese companies are poised to accelerate international investment in clean energy technology and fill the void left by such major economies as the US, new data shows.

A new report from the Institute for Energy Economics and Financial Analysis (IEEFA) reveals that China invested a record US$32 billion (220 billion yuan) in overseas renewable energy and related technologies last year, marking a 60% year-on-year increase in spending.



Source: World Resources Institute, April 2013

Over the period 2015-2021, China will install around a third of the world's total wind energy, solar and hydroelectric generation capacity. Meanwhile, China-led lending institutions, such as the Asia Infrastructure Investment Bank (AIIB) and the Export-Import Bank of China, have enough financial capacity to lead electricity-sector transformations across Asia.

The scale and growth of this investment indicates that China is ready to embrace the role of global leader in the 21st century's "clean energy era" with future US environmental policy under a Trump administration uncertain.

"The US is already slipping well behind China in the race to secure a larger share of the booming clean energy market. With President-elect Trump talking-up coal and gas, prospective domestic policy changes don't bode well," said Tim Buckley, director of energy finance studies, Australasia, at IEEFA, in a statement.

"If the US is serious about stimulating manufacturing based growth, this isn't a sector to turn your back-on," he added.

China is already a leader in terms of domestic investment in renewable energy. On Thursday 5, an announcement from China's National Energy Administration (NEA) revealed that China will plough 2.5 trillion yuan (US$361 billion) into renewable power generation by 2020, as part of its five-year economic development plan (The 13th Five-Year Plan), as it shifts its domestic market away from dirty coal power towards cleaner fuels.

Top Five Destinations for Accumulated Chinese Investment (US$m)

Country	Total value 2005-2013	Global share (%)
China	59,900	13
Australia	57,250	12
Canada	37,650	8
Brazil	29,180	6
Britain	18,530	4

Source: "Demystifying SOE Investment in Australia", KPMG & Uni of Sydney, August 2014, The Heritage Foundation China Global Investment Tracker database.

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Part of this "Going Global" strategy dovetails with plans to build a series of trade and infrastructure networks across Asia reaching as far as Europe, under the banner of "One Belt One Road" or the "New Silk Road".

This means that China will become the world's largest employer of green energy jobs globally. The International Energy Agency's World Energy Outlook for 2016 estimates that Chinese firms hold 3.5 million of the 8.1 million renewable energy jobs worldwide. This compares to the 769,000 jobs dependent on renewables in the US.

The bulk of Chinese investment in wind and solar energy installation is being channelled into the US, Germany, Italy, Australia and South Africa. In terms of new markets, Latin America is currently one of the most attractive regions for renewable energy development and Chinese companies are already invested heavily in Mexico, Brazil, Argentina, Chile, and elsewhere in the region.

In 2016, Tianqi Lithium, China's largest extractor of lithium from ores, invested US$2.5 billion (17.2 billion yuan) in acquiring a monitor stake in SQM of Chile, the

world's fourth largest lithium farm. Lithium is used to make batteries for electric vehicles. Over the next nine years global demand for the metal for battery use will double, according to IEEFA's report.

In the other strategic area of grid transmissions, the State Grid Corp of China (SGCC) last year pledged US$13 billion (89.5 billion yuan) towards an energy and electricity and distribution deal with Brazil's CPFL Energia SA. The influx of Chinese money in Latin America is expected to have serious implications for regional geopolitics, adding to competition from US and European countries over influence in the region.

"China understands that renewables present a huge commercial opportunity. Staggering domestic investment in a move to clean energy, compliments its active pursuit of commercial growth overseas. As the US owned the advent of the oil age, so China is shaping-up to be unrivalled in clean power leadership today. The US may look back in regret in years to come," said Buckley.

Charlotte Middlehurst is a London-based journalist with a special focus on China and the environment.

厄瓜多尔需仔细甄选中国能源投资

中国正以巨额资金支持的厄瓜多尔能源项目，很多具有较大环境影响。

□ 宝琳娜·加尔松

上世纪20年代中期，中拉关系在南南合作的旗帜下开始迅速发展。2014年，中国国家主席习近平提出，中拉合作将以“包容、可持续的合作规划”为指导。本月早些时候，中国与厄瓜多尔达成共识，将双方关系升级为“全面战略合作伙伴关系”。这一升级对厄瓜多尔金融和能源部门有着怎样的实际意义呢？

中国在帮助厄瓜多尔获得融资以及实现能源结构转型方面发挥着重要作用，而厄瓜多尔则是中国银行及企业的重要客户。2009年以来，厄瓜多尔从美洲开发银行（IDB）获得融资42.6亿美元（295亿元人民币），从拉丁美洲发展银行（CAF）获得融资38亿美元（263亿人民币），但与中国的银行提供的137亿美元（948亿元人民币）相比，这些都相形见绌。目前，厄瓜多尔的外债规模比2008年总统科雷亚宣布放弃偿还外债时的规模还要大。

在中国等国贷款的支持下，厄瓜多尔电力项目大增。科雷亚总统表示，目前厄瓜多尔是全球能源结构最为清洁的国家之一。但这一说法还有待商榷。

科卡科多-辛克雷这样的大型水电项目会给环境带来巨大影响，特别是热带森林中的水电项目。有强有力的科学证据可以证实这一点。事实上，美国进出口银行已于2014年禁止为大型水坝提供资金。

中国在风能和太阳能等可再生能源领域的投资是有限的，风能项目投资仅占总投资额的1.2%，而对太阳能项目的投资额则为零。

大量投资持续涌入高碳项目。如果厄瓜多尔政府继续拿着中国的钱扩张石油开采，侵蚀本国最大的自然保护区亚苏尼国家公园，并在太平洋沿岸建设拉美地区最大的冶炼项目——太平洋炼油厂，那么要想“净化”其国内（和国际）能源结构将毫无可能。

目前，厄瓜多尔国内建成的10座水电站中有6座是由中国进出口银行和中国国家开发银行支持的，金额总计29亿美元（200亿元人民币）。这6个项目的中国承建企业的大坝及隶属工程建设收入高达47亿美元（325亿元人民币）。除了这几个水电项目，中国企业还承建了其他一些道路、桥梁、医院以及学校建设项目，这说明中国企业是厄瓜多尔公共工程事业的主要承包方。

厄瓜多尔需要重新定位其与中国的关系。近年来，中国已经在本国经济“绿色化”以及可再生能源推广方面采取了令人印象深刻的行动。最近，中国还出台了银行系统绿色信贷相关的政策制度，其中包括致力于关闭燃煤电厂，以及在国家支持下建立全球最大的太阳能电池板工厂等。

中厄两国如果想要建立真正意义上的全面战略合作伙伴关系，就必须重视发展对环境无害的低碳项目，为厄瓜多尔人民带去真正的经济利益。这一点必须摆在中厄关系的核心位置。

宝琳娜·加尔松，厄瓜多尔人，拥有25年拉丁美洲环境及国际金融机构相关工作经验

Ecuador must re-invent its relationship with China

China is investing heavily in Ecuadorian energy projects that have serious environmental impacts

□ Paulina Garzón

President Rafael Correa of Ecuador with Chinese president Xi Jinping

The China-Latin America relationship took off in the mid-2000s under the banner of South-South Cooperation. In 2014, President Xi Jinping said that China-Latin America cooperation would be guided by an "inclusive and sustainable cooperation plan". Earlier this month, Ecuador and China agreed to upgrade their relationship to that of a "Comprehensive Strategic Partnership". But what are the practical implications of this for the financial and energy sectors in Ecuador?

China has been essential to helping Ecuador access capital

and transition its energy mix. In return, Ecuador has been an important customer for Chinese banks and companies. Since 2009, Ecuador has received US$4.26 billion (29.5 billion yuan) from the Inter-American Development Bank (IDB), and US$3.8 billion (26.3 billion yuan) from the Development Bank of Latin America [Corporación Andina de Fomento (CAF)]. However, this pales in comparison to the US$13.7 billion (94.8 billion yuan) from Chinese banks. Currently, Ecuador's external debt is greater than in 2008, when President Correa famously defaulted, deeming repayment to creditors impossible.

Chinese loans, among others, have resulted in a dramatic increase in electricity projects in Ecuador. According to President Correa, Ecuador now has one of the cleanest energy mixes in the world. But this claim deserves closer scrutiny.

Major hydroelectric projects such as Coca Codo Sinclair have enormous environmental impacts, especially those in tropical forests. There is robust scientific evidence to support this. So much so, in fact, that the US Exim Bank banned the funding of large dams in 2014.

Chinese investment in renewables such as wind and solar is limited. A mere 1.2% of Chinese funding for power generation has been directed towards wind energy projects and no funds have gone into solar energy.

Significant investment also continues to flow into high carbon projects. It will be impossible to "clean" the domestic (and global) energy mix if the Ecuadorian government, supported by China, continues to expand the oil frontier into the mega-biodiverse Yasuní National Park, and develops the mammoth Pacific Refinery project, which aims to be the largest refinery on the Pacific coast in Latin America.

The Export-Import Bank of China (Chexim) and China Development Bank have provided US$2.9 billion (20 billion yuan) for six of the ten hydroelectric plants that have been built in the country. However, Chinese companies developing these six projects have received US$4.7 billion (32.5 billion yuan) for the construction of these dams and other supplementary works. These deals, combined with others for the construction of roads, bridges, hospitals and schools, mean Chinese companies are the main recipients of public works contracts in Ecuador.

Ecuador needs to re-invent its relationship with China. In recent years, China has taken impressive steps towards "greening" its economy and promoting renewable energy. The latest green policies of the Chinese banking system, including a commitment to close coal production plants and provide state support to establish the largest solar panel factory in the world, are just a few examples of China's capabilities.

A focus on environmentally sound, low carbon projects that deliver real economic benefits to Ecuadorians must be at the heart of the China-Ecuador relationship if the two countries wish to establish a truly meaningful Comprehensive Strategic Partnership.

This blog is republished from Diálogo Chino

Paulina Garzón is an Ecuadorian native, with 25 years of experience working on issues relating to the environment and international financial institutions in Latin America.

气候适应：一道中国式难题

在庞大的中国，气候变化的地区影响千差万别，适应工作将对政府的管理能力发起巨大挑战。

□ 梁 丽

从古至今，洪水、干旱和热浪始终未曾放过中国。可以预见的是，随着全球平均温度的上升，此类极端天气事件发生的频率、强度和地区分布都将有所变化，由此导致的气候风险也难以预料。

气候风险分急性和慢性。发生严重气候灾害的可能性以及人们在不同灾害面前的脆弱性并不确定——这些灾害可能是缓慢发生的如海平面上升和干旱，也可能是极端的，如台风和热浪。

中国幅员辽阔、地形多变，要适应各地不同的气候风险尤为困难。气候变化对各地季节性天气模式和气候的影响各有不同，再加上各地区人口统计数据、自然资源、地形以及社会经济发展水平等方面的巨大差异，使得气候适应工作具有难度。例如，高度城市化地区和欠发达农村地区面临的气候风险可能截然不同。

中国政府面临的挑战是，解决并把握气候变化带来的风险与机遇，同时还要实现长期经济社会发展目标。

艰巨的挑战

中国的气候确实在变化。从1951到2009年，中国年均温上升了约1.4摄氏度。气温的升高导致区域降水发生了重大变化，北方年降水量不断减少，南方长江中下游地区降水则逐年增加，因此出现了“南涝北旱”，即南方洪水泛滥、北方却饱受干旱和水资源短缺问题的困扰。

中国不仅必须解决水土污染、水土流失、土地退化及生态系统和栖息地丧失的问题，还必须继续用仅占全球9%的耕地和6%的可再生水资源养活全球七分之一的人口。此外，发展不平衡、城市化、城乡人口流动和工业化发展确实提高了一些人的生活水平，但同时也令另外一些人生活更加艰难。

气候影响的模式也并非一成不变。例如在广东省广州市，由于沿海低洼地区的快速城市化，天气灾害对该地区居民的影响日益加重。面对日益频发和加剧的热带气旋和风暴潮，当地政府必须采取行动保护那里数量不断增加的人口和他们赖以为生的基础设施。

无独有偶，由于温度上升和铁路建设，平均海拔超过4000米的西藏出现了未曾有过的蚊子种群。2009年，拉萨市居民开始报告当地出现大量蚊子，那年夏天尤为炎热，白天温度最高达到30.4摄氏度，远高于该地区夏季白天22.5摄氏度的平均温度。这些蚊子被认为是在该地区传播西尼罗河热以及丝虫病的元凶。而当地居民没有应对大量蚊子的经验，对此毫无准备。

升温与农业

气候变化的影响并非全是负面的。气温上升延长了中国北方的农作物生长期，减少了寒冷天气对作物的伤害。在一些地区，适合耕作的土地面积扩大，更长的生长季节使一些作物在一年内可以种植两季甚至更多。北部和西部地区的农户也开始

种植南方水稻品种和冬小麦作物。

气候变化也扩大了农作物种植总面积。全国复种指数(即年内耕地上农作物总播种面积与耕地面积之比)从1985年的143%上涨至2001年的164%，其中一部分原因在于青藏高原等高原地区种植面积的扩大。

适应复杂多变的气候

气候变化影响的预测和应对是一项极为复杂，并且需要耗费大量资源的工作。无论对决策者、企业还是个人来说，气候适应都十分令人头疼，因为未来需要适应的不是一个既定、单一的气候，而是一系列变化中的气候、环境和社会经济条件。这些变化意味着不同的人群、资产、基础设施和经济部门面临的风险各不相同，且不均衡。

单一措施很少能实现有效适应。相反，只有将政策和行动相联系，并且加强能力建设确保适应措施的执行，才可能实现这一点。中国必须针对水资源保护、灾害风险控制、人类健康、能源基础设施、草原/畜牧业、沿海地带管理、农业和旅游业等部门制订全面综合的适应措施。

2013年，中国发布《国家适应气候变化战略》，该战略是包括中国气象局和农业部在内的12个国家部委和政府机构在国家发展和改革委员会(发改委)协调下历时2年多的工作成果。

该战略可以说是中国迄今为止最为重要的气候适应政策，它让中国的气候适应工作从评估走向政策制定，并通过针对省级政府和主管部门的一系列指导方针为省市级适应规划的制定提供了框架。发改委官员强调，该战略并不是一份计划，而是一个需要时间来执行的工作纲要。

2016年2月，国家发改委与住房和城乡建设部起草了《城市适应气候变化行动方案》，具体细节有待公布，但其目标是在2020年之前覆盖30个试点城市。

由于气候条件已经发生变化，社会适应的压力很快显现，基础设施建设一时难以跟上，部门层面的规划者开始采用软、硬结合的方法来建设抵御灾害的能力。中国已经采取关键举措，推动水资源管理政策朝着更加全面、更具前瞻性思维的方向发展，将水资源系统的抗灾能力视为适应气候变化的一部分。

决策者也更加注重保育、保护工作，以及分配政策的变化。例如，中国通过制定《全国水资源综合规划》，开始更多地采取一体化的流域管理方式。

适应要以科学为本

人们开始更多地利用卫星数据等遥感手段来获取更加及时详细的灾害风险信息。中国开发了一套灾害性天气气候地图，帮助改善了台风、暴雨以及干旱风险的评估。此外，中国还发布了《气候变化国家评估报告》，以及长江流域、华东地区、云南省、鄱阳湖和三峡坝区的气候影响评估报告。

然而，在省一级，气候适应要么没有得到一致重视，要么没有被纳入省级五年发展规划之中。国家发改委承认许多省级和地方官员没有能力制定适应规划。内蒙古和广东等地在这方面领先于其他省份。

内蒙古自治区发展研究中心计划于2017年3月底之前出台一份雄心勃勃的规划，内容涉及水资源、农林业、生态、城市化、能源和草地畜牧业等领域。

广东省正在努力修复占地650公顷的淇澳红树林自然保护区。珠江三角洲汇集了数座大都市，但生态退化和污染已经破坏了该地区沿海生态系统缓冲台风和海潮冲击的能力。

红树林在降低灾害风险、协助气候适应工作中的重要性正日益受到重视。2008年，广东省遭台风“黑格比”重创，与健康的生态系统相比，人造基础设施的御灾能力相形见绌。台风对珠海市造成了巨大破坏，三分之一的花岗岩海堤被摧毁，但附近的淇澳红树林自然保护区却丝毫不受影响。

在适应气候变化的过程中，中国领导人要应对的不仅仅是多样的地理环境、庞大的人口数量、各种亟待发展的事项，还要应对区域间不断扩大的经济差距。

中国为了维护生态系统健康，提高国民生活水平，已经费尽心力，气候变化的出现无疑添加了新的压力。中国决策者、企业和公民必须在这一充满挑战的背景下，更好地管理气候风险，增强自身抵御气候灾害的能力。

因此，以风险为基础制定综合性适应政策和规划是保护弱势群体、阻止环境退化的关键所在。只有这样，中国才能实现惠及全民的可持续发展。

梁丽，海外发展研究院风险和恢复力的项目主管

China must step up adaptation efforts

With typhoons, rainfall and drought all expected to increase, provinces must do more to adapt

□ Rebecca Nadin

China has faced floods, droughts and heat waves for millennia but as the average global temperature increases, we can expect the frequency, intensity and distribution of these extreme weather-related events to change.

Climate risk can be understood as the potential severity of impacts, taking account of underlying vulnerability and the probability of occurrence of a severe hazard, which may be slow-onset, such as sea level rise or drought, or an extreme weather event like a typhoon or heat wave.

China's size and varied geographies make adapting to the wide variety of climate risks especially difficult. Climate change alters seasonal weather patterns and local climates

Once fertile, these fields outside Gurao in Shantou, Guangdong province, have now been abandoned. China must address climate risks while ensuring socio-economic development

differently but adaptation must also consider the significant differences in regions' demographics, natural resources, topography, and levels of socio-economic development. The climate risks faced by highly urbanised areas, for example, may be quite different to those of underdeveloped rural ones.

The challenge for China's central government, then, is to address the risks and opportunities of a changing climate whilst also meeting long term socio-economic goals.

The scale of the problem

China's climate is changing. The annual mean temperature rise from 1951-2009 was about 1.4C. This has contributed to profound shifts in regional precipitation, with annual rainfall decreasing in the north and increasing in the middle and lower Yangtze River Basin in the south. It's caused droughts and water shortages in the north and heavy flooding in the south, a phenomenon called the South Flood and North Drought.

China must get to grips with polluted water and soil, soil erosion, land degradation, and ecosystem and habitat loss. It must continue to feed one-seventh of the world's population with just 9% of its total arable land and just 6% of global renewable water resources. Uneven development, urbanisation, rural-to-urban migration and industrial development have improved living standards for some while increasing socio-economic inequality for others.

Vulnerabilities to climate impacts are not static either. For example, in Guangzhou, southern Guangdong province, rapid rates of urbanisation along low lying coastal areas are increasing people's exposure to weather hazards. Authorities must protect these growing populations and the infrastructure they depend on from increasingly intense and frequent tropical cyclones and storm surges.

Similarly, in Tibet, where the average altitude is more than 4,000 metres, mosquito species not previously recorded have established populations as a result of warming temperatures and the construction of the Qinghai-Tibet railway.

In 2009, residents of Lhasa city started reporting large numbers of mosquitoes when daytime temperatures reached a record 30.4C, much higher than the average daytime summer temperature of 22.5C. The mosquitoes are believed responsible for the spread of diseases such as West Nile virus and filarial worms in the region. With limited experience of living with large numbers of mosquitos, the local population was unprepared.

Some benefits

Not all impacts from climate change are harmful though. Rising temperatures have extended the growing period in northern China and reduced crop damage from cold weather. In some areas, land suitable for farming has expanded and the longer growing season has allowed famers to plant more than one crop a year. Farmers are planting southern rice varieties and winter wheat crops further north and west. The national cropping index (the ratio of the total area sown with crops to the total amount of cultivated land in a country each year) is up from 143% in 1985, to 164% in 2001, in part because of greater cultivation in the Tibetan Plateau and other highland areas.

Adapting to uncertainty

Anticipating and responding to climate change impacts is complex and resource intensive. Climate adaptation is a headache for policymakers, businesses and individuals because there's no single, known future climate to adapt to but instead a changing set of climate, environmental and socio-economic conditions. These changes mean that different groups of people, assets, infrastructure and economic sectors face varied and uneven risks.

Effective adaptation seldom consists of a single measure. It depends on linking policies and actions, and building capacity to implement them. To do this, China must develop comprehensive and integrated adaptation measures for sectors such as water resources, disaster risk reduction, human health, energy infrastructure, grasslands and animal husbandry, coastal zone management, agriculture, and tourism.

China released its National Adaptation Strategy (NAS) in 2013, the result of more than two years work by 12 ministries and government agencies, including the China Meteorological Agency and Ministry of Agriculture. It was coordinated by the National Development and Reform Commission (NDRC).

The NAS is arguably China's most important climate adaptation policy to date. It shifts China's adaptation response beyond assessment to the development of policies, providing a framework for Urban and Provincial Adaptation Plans through a set of guiding principles for provincial governments and line ministries. NDRC officials emphasise that the strategy is not a plan but rather an outline of work that will take time to implement.

Most recently, in February 2016, the NDRC and the Ministry of Housing and Urban-Rural Development drafted the Urban Climate Change Adaptation Action Plan. The details are yet to be released but the ambition is that by 2020 the plan will cover 30 pilot cities.

As climate conditions have begun to shift and social pressures evolve faster than infrastructure can keep up, sector level planners are turning to a combination of options to build resilience. China has started to make crucial steps toward a more holistic, forward-thinking water resource management policy that views water system resilience as part of the overall process of adapting to climate change.

Policymakers are also moving toward a stronger focus on conservation, preservation and changing allocation strategies. China is beginning to take more of an integrated river basin management approach, for example, through the development of a National Comprehensive Water Resources Plan.

Science based adaptation

Satellite data and other remote sensing tools are also being used more to provide a detailed and up-to-date picture of disaster risks. China recently developed a meteorological disaster atlas and has improved risk assessments for typhoons, rainstorms and droughts. There are also National Assessment Reports on Climate Change and impact assessment reports for the Yangtze River Basin, East China, Yunnan province, Poyang Lake and the Three Gorges Dam area.

However, at the provincial level, adaptation is not being uniformly addressed or integrated into five-year development plans. The NDRC acknowledges that many provincial and local officials lack capacity for adaptation planning. Some provinces, such as Inner Mongolia and Guangdong, are further along than others.

In Inner Mongolia, the provincial Development Research Centre is embarking on an ambitious plan to be completed by the end of March 2017, that will cover water resources, agroforestry, ecology, urbanisation, energy, and grassland husbandry.

Guangdong province is working to restore Oi'ao Nature Reserve, a 650-hectare expanse of mangrove forests. Ecological degradation and pollution have compromised the ability of the Pearl River Delta's coastal ecosystems, where many major cities are located, to buffer the forces of typhoons and high tides.

Mangroves are increasingly seen as essential to disaster risk reduction and climate adaptation efforts. Typhoon Hagupit pounded Guangdong in 2008 and revealed the resilience of healthy ecosystems compared to man-made infrastructure. While the typhoon caused enormous damage to Zhuhai city, destroying one-third of its granite seawall, the nearby Oi'ao Nature Reserve was unaffected.

In adapting to climate change, China's leaders must contend with the country's diverse geographies, vast population and competing development priorities, as well as the increasing economic disparity across regions.

Climate change poses an additional stress factor at a time when the country is already struggling to maintain healthy ecosystems and raise living standards. It's within this challenging context that China's policymakers, businesses and citizens must manage climate risk and build resilience.

Comprehensive risk based adaptation policies and plans are therefore essential to protecting vulnerable groups from hardship and arresting environmental degradation. Only then can China achieve sustainable development for all.

Rebecca Nadin is Head of Risk and Resilience at the Overseas Development Institute (ODI)

被洪水围困的浙江村民

对于饱受台风和内涝困扰的浙江平阳来说，如何让城镇建设适应越来越严重的气候变化影响已成当务之急。

□ 何林璘

需要更好的土地利用规划和建筑设计，以限制极端天气事件的影响，比如9月份的台风

“真没想到爷爷这么恋家的人搬家会这么开心。”家住浙江省温州市平阳县的毛毛（化名）向记者感慨。刚刚过去的2016年对这个小家庭来说，是变动巨大的一年。

2016年年末留学回国的她带着爷爷奶奶义无反顾地离开了居住了几十年的故乡麻步镇。“家里实在没法继续住了。”她说。

就在2016年秋天，麻步镇曾一度变成一片汪洋。

2016年9月底，该年第17号台风“鲇鱼”从福建南部登陆，温州多地打破多项超强降雨历史纪录，温州市平阳县的部分地区24小时降雨量均超过了当地有气象观测记录以来的历史最高水平，其中麻步镇最高水位高达到9.8米，水头镇最高水位达11.38米，均超历史最高。

在平阳县，内涝并非新鲜事。但此次历史最高水位的“满水”却成

了促使一些居民搬离家乡的“最后一根稻草”。

而面对极端天气的不断增多，更多的居民仍然只能留在这片“泽国”。如何在这个被水围困的城镇适应与生存，不再只是居民们所考虑的问题，同时也成了当地政府决策的重要考量。

水漫金山

2016 年 9 月底的那场台风里，毛毛 80 多岁的爷爷奶奶已经不太记得那 48 小时是怎么熬过来的。滂沱大雨不停地下，“跟盆泼得差不多。”麻步镇的水位从 9 月 28 日早上开始上涨。

84 岁的奶奶按照以往镇里“满水”的惯例做法，蹒跚着脚步自己把冰箱和煤气罐拖到了二楼，其他家电也都挪到了高处。

“满水”是水头镇、麻步镇等地的居民对于被淹的俗称，本是当地人习以为常的事。在毛毛的童年记忆里，从前每年台风来的时候是孩子们最开心的时候。大人在二楼搓麻将，孩子们在街上踩水玩。“那时候，满水顶多也就满到腿，把一楼的东西往高处放就没事儿了。”

但 9 月 28 日那天的情况不一样。下午 5 点左右，水位涨势变快，“差不多每五分钟水就涨高一个台阶”。家里的很多家具来不及挪，就被泡在了水里。停水停电，手机通讯信号时好时坏，老两口就这样被困在自家“孤岛”上，与世隔绝了两天两夜。

被困的不仅仅是这两位老人。9 月 28 日之后的两天，麻步镇变成了一片汪洋，人们躲在一座座建筑的二楼以上楼层，各个“孤岛”隔“海”相望，一楼房间几乎全部被浸泡在水里。“孤岛”状态持续了三天。

直到三天后水势才基本褪去，街道和屋内却被厚达三四十公分的淤泥覆盖，“胶鞋踩进去都拔不出来”。为了清理屋内的淤泥，有居民甚至花 600 块买来消防水管，“从河里抽水冲洗”。各家服装店忙着清洗自家被泡的衣服，一位店主向记者吐苦水：“一个人根本忙不过来，专门雇人 300 块一天帮我们一起洗衣服，就这样还洗了四五天。”

而不少从屋内清扫出的垃圾，至今也依然堆在街道上无人清理。

根据官方统计，“鲇鱼”台风期间，造成全县 90 多条道路塌方。平阳县受灾人口多达 31.0968 万人，农作物受灾面积 11.6175 万亩，直接经济总损失 10.359 亿。

作为当地的“九溪汇合之处”，水头镇上游来水丰富，成为雨水汇集的地方。由于这一特殊的地理位置，“满水”对水头镇和位于其下游的麻步镇居民来说并非新鲜事，但水位满到如此之高，却是他们从未经历的。

刘芳（化名）因今年的满水，服装店铺损失了十几万，“本来衣服放在往年的高度肯定不会被泡，没想到水满了这么高！”家里没来得及搬走的冰箱、洗衣机等家电也因水长时间的浸泡，再也修不好了。刘芳计划年后关掉店铺，赶在新的台风季到来之前搬离水头镇。

“年年这么泡，水位越来越高，啥时候是个头啊！”她向记者抱怨。

> “近些年，当地人直观地感受到了气候的反常。镇里满水的水位从以前的不到1米涨到了超过1层楼的高度。”

愈发“奇怪”的天气

在已从事了 38 年抗台防汛工作的平阳县防汛办公室主任冯力眼里，县里这些年的天气变得和往常更不一样了。台风所带来的降水似乎更无规律可循。

“今年确实很奇怪。”平阳县气象局副局长刘峰说，“按往常来说，从福建南部登陆的台风对我们这边的影响并不大，因为距离比较远，没有预料到它会给平阳带来这么大、这么集中的强降雨。”

近些年，当地的人们直观地感受到了气候的反常。镇里满水的水位从以前的不到 1 米涨到了超过 1 层楼的高度。

10 年间，麻步镇刘楠（化名）家的五金店搬了 4 次，一次搬得比一次地势高。“因为这些金属配件经不起水泡，我们只能往更高处搬。”

如今刘楠的店铺已经坐落在了麻步镇上的地势最高点。为保险起见，他们甚至额外垫高了半米高。“前些年满水，基本都满不到我们这里。”但今年的“鲇鱼”来袭，这个位于全镇最高点的店铺也依然没挡住水漫进来。

在平阳县住房建设局编制科负责人李其武看来，导致满水的因素有很多，该县所处的地理位置是主因。但他也认为，近些年极端天气所

带来的高频次、大强度的降雨也是其中不可被忽略的重要因素。

对于近年来强降雨天气增多的气候原因，“全球气候变暖作为首要因素”已经成为不少专家的共识。

据南京水利科学研究院院长、中国工程院院士张建云公开表示，全球变暖一方面导致水文循环过程加快，海洋蒸发增加，另一方面大气本身的含水量也增加。中国科学院大气物理研究所特聘研究员黄刚也认为，从全球变暖规律上来说，中国东部强降水的趋势在增多，小降雨减少，大暴雨增多。

刘峰则解释称，因为空气中所携带的水分变大，一旦发生降水，降雨强度就会比以往大。同时潮湿和温暖的大气稳定性较差，也更加容易形成大暴雨过程。

在从2014年持续到2016年5月的超强厄尔尼诺作用下，2016年上半年全球遭遇创纪录的高温天气。据世界气象组织统计，2016年是人类有记录以来最热的一年。

“受2015/2016强厄尔尼诺现象的影响，长达数十年的气候变化趋势正达到新高潮。”世界气象组织秘书长佩蒂瑞·塔拉斯说。

“2016年下半年的这些台风异常显然还是厄尔尼诺现象的影响结果。虽然厄尔尼诺理论上已经结束，但实际上厄尔尼诺的影响并没有消失。”刘峰解释说。

防汛办主任冯力指着气象云图告诉记者，工作几十年他还从没见过像那样海面上有3个台风同时存在的场面。

脆弱的城镇

地方政府必须将气候变化风险纳入地方规划

在已经习惯了每年台汛期就“满水”的水头镇等地，人们发明出了一套自己的“适应办法”。

当地人所建的房子大多数一层楼都高达三到四米，甚至有不少房子被改建成“小二层”，“这是我们这边的特色，为的就是防止满水满得太高，满水了还可以在小二层呆着。”刘芳说。

几乎没有住宅将厨房设置在一楼，“因为一旦满水，抽油烟机，煤气灶这些没法动的就全泡坏了。”

“这几年暴雨极端天气变多，以前粗放的城镇化建设明显应对不了这些变化，城市的内涝、洪水灾害的风险明显上升。”平阳县住建局编制科李其武感叹。

而对于平阳县来说，这一弊端凸显得尤其明显。

平阳县水利局局长刘纪动向记者坦承，平阳县大多数地区的防洪标准都非常落后。尤其是水头镇和麻步镇等地的防洪标准很低，甚至仅能抵御一年一遇的洪水，远低于规定的20年一遇防洪标准。“防洪水利投入少。这是历史遗留原因。”刘纪动解释说。

逢雨必涝几乎成了平阳县不少乡镇的通病。

据记者了解，从水头镇到鳌江干流之间，长期处于低标准堤防甚至无堤防的状态，常常是遇到不足两年一遇的洪水就会出现漫滩倒灌造成洪灾的情况。

随着城镇化进程的推进，在水头镇和麻步镇等地，河道被填平建房，建筑物不断侵占原本的行洪道，使得洪水下泄不畅。甚至有不少行洪区建筑物向河道内扩张，造成行洪断面减小。

水头镇重要的皮革产业基地就建在了行洪区内。溪床边、河滩地各处均被用来建房办厂，企业、民房纷纷建在原规划为行洪道的细滩上，使得行洪道的面积比原本规划的减少了近2.1平方公里。

“以前水头的水面很多。现在水头镇连个像样的河道都没有，河道被填掉，人为占地，一所中学直接建在了堤坝上。”冯力说。

平阳县行政综合执法局市政公用科科长谢作星认为，尽管城镇规划建设提倡长久计划，但在过去几十年里，城市内涝从来都不被认为是一个问题，“没有问题怎么会想到去解决呢？为了还没出现的问题而花钱投入，领导也不会乐意。城镇发展更多的关注点还是在经济效益上。”

缺乏科学合理规划的城镇化建设，在气候变化的作用下，显得措手不及。

在规划建设中考虑气候变化

20 世纪 90 年代来，中国平均每年因极端天气气候事件造成的直接经济损失超过 2000 多亿元。

清华同衡规划设计研究院生态城市研究所所长邹涛表示，我国的城市规划应更多地关注极端气候事件的增多趋势，将气候变化的因素放入规划建设的考虑范围中，将“小概率事件”纳入研究范畴。

而这也正是于 2016 年年初发布的《城市适应气候变化行动方案》的思路。这份由国家发改委、住建部会同有关部门共同印发的文件提出，要有效提升我国城市的适应气候变化能力，在城市相关规划中充分考虑气候变化因素，统筹协调城市适应气候变化相关工作。

适应气候变化？在平阳县，记者所接触到的几乎所有政府部门对这个概念都很陌生。

面对全球气候变化，过去被更多提及的是减缓措施，如减少碳排放等。但如何适应已出现的气候变化趋势，如极端天气的增多，是被大多数人忽视的重要主题。早在国家十二五规划中，就已明确提出要增强中国的适应气候变化能力。2013 年 11 月国家发改委、财政部、住房城乡建设部、气象局等 9 个部门制定发布《国家适应气候变化战略》。

“概念陌生并不代表所做的事与适应气候变化无关。”邹涛解释说，很多地方正在做的事实际上都和适应气候变化相关，只是“现在将这个概念单独强调出来”。

参与编制该战略的国家发改委应对气候变化司有关负责人告诉记者，适应气候变化是个系统工程，“在不同的领域都有考虑。如大气和水相关的政策中，都有与适应气候变化相关的内容。”

2016 年 8 月，国家发改委和住建部联合印发关于开展气候适应型城市建设试点的通知，计划在全国选择 30 个典型城市进行气候适应型城市建设试点。

前述负责人认为，推进适应气候变化的工作是层层推进的问题。把在战略规划中所要求的内容与基层具体工作相结合，不是一蹴而就的过程。

据平阳县当地官员向记者透露，“鲇鱼”台风之后，县领导在内部开会时曾提及希望将部分地区的防洪标准提高至可防御 50 年一遇洪水，这使得该县水利部门工作人员面露难色。但“鲶鱼”台风之后，各级部门的确正在就“‘极端天气增多’纳入规划建设考虑范围”达成共识。

“适应气候变化与其他工作本身是一个协同性工作。需要各个部门共同发挥作用，增加决策的科学性，否则很难推动。”邹涛表示。

对这一点，平阳县气象局副局长刘峰深有体会。从 2009 年起，国家气象局就已发布实施《气候可行性论证管理办法》，称关于重大项目和城市规划等应当展开气候可行性论证的要求。“但这一指令是国家气象局通过气象局系统下发的规定，到基层很难实施。作为县级气象部门，我们只能提出要求和建议，不能强制别的部门配合。”

他还坦承，该局 2016 年曾首次尝试建议本地一风电项目开展气候可行性论证，“因为项目较大，涉及到电力，”建议后至今未果。记者从该县发改局投资办获知，气候可行性论证并不被作为重大项目批复的前提条件。

城镇化建设中，大多数城镇像平阳一样匆忙。

截至 2015 年，城镇人口已占全国总人口比重的 56.1%，全国在城镇生活的人口多达 7.7 亿人。

面对被填平的河道、硬化的路面、建设引起的水土流失等，中国城市规划设计研究院副院长邵益生表示，在规划建设过程中对气候变化因素考虑不足，缺乏对未来气候变化的预见性的中国城镇，应更加重视气候变化带来的影响，要研究制订更科学、适应性更强的技术标准，完善相关的管理制度，提升对极端天气的适应和应对能力。

极端天气增多的情况下，毛毛和她的家人选择搬离数十年的故乡。但更多人因为生计与生活选择留下。前述发改委相关负责人在强调地方政府主动适应气候变化的同时，还呼吁：“关注气候变化并适应变化是一个社会意识提高的过程，公众的重视也同样重要。”

何林璘，《中国青年报》记者

Zhejiang villagers fight flood damage, others leave

Battered by typhoons and flooding, Pingyang county in Zhejiang shows why adaptation to climate change is urgently needed

□ He Linlin

"My granddad loves his home, I never thought I'd see him so happy to move," says Maomao (who prefers not to give her real name). Her family lives outside the Zhejiang city of Wenzhou in south-east China. Last year brought with it some huge changes for the family.

At the end of 2016, Maomao returned from studying overseas to help her grandparents move from Mabu town, where the family had lived for decades. The family felt compelled to move following a typhoon in autumn that transformed the area into a huge expanse of water.

"There was just no way we could keep living there," says Maomao.

In September, Typhoon Megi, China's 17th of the year, made landfall in southern Fujian, shattering historical rainfall records across Wenzhou. Water levels in the towns of Mabu and Shuitou reached 9.8 metres and 11.38 metres, respectively, setting new highs.

Pingyang county is used to flooding but this time the damage was so extreme that some residents decided they had had enough. Others had no choice but to stay in their waterlogged homes, despite the ongoing threat of severe flooding in future.

Rising waters

Maomao's grandparents don't remember much about how they coped with the worst 48 hours of the typhoon. On the morning of September 28 the rain just poured down, "almost by the bucket," to the point where water levels in Mabu started to rise.

Maomao's 84-year-old grandmother did what the locals always do when this happens. With difficultly she moved

> "Normally the high water mark from flooding is less than one metre high. Now it's the height of a single storey building."

the refrigerator and gas cylinder up to the second floor along with all the electrical appliances.

People in Shuitou and Mabu are so used to flooding they refer to it as their homes becoming "full". Maomao remembers typhoon season as a happy part of her childhood. The grown-ups enjoyed games of mah-jong upstairs while the children would play in the flooded streets.

"Back then it would only get 'full' up to your legs, so you just had to shift everything upstairs and it was fine," says Maomao.

But this time was different. At about 5pm on the 28th the water level started to rise rapidly. "It rose another step about every five minutes."

There wasn't time to shift much of the furniture, which had to be abandoned. The water and power supplies were cut and the mobile phone signal faded in and out. The elderly couple spent two days and nights marooned on their own little "island".

They weren't the only ones. For two days, Mabu was a huge expanse of water, its residents taking refuge in any building with two or more storeys. Neighbours could see each other across the floodwaters but were unable reach each other.

Only after three days did the waters recede, leaving behind floors and streets caked in a foot or more of mud. "You'd step in with your rubber boots and not be able to get them out again," says Maomao

Some people purchased fire hoses to pump water from the river to wash the mud away. Liu Fang (who chose not to give her real name) runs a clothing store and lost well over 100,000 yuan (US$14,500) of stock in the floods.

"I'd put everything up high, high enough a usual flood wouldn't have got near it, but I didn't know it was going to be this bad!" Appliances including a refrigerator and washing machine were unrepairable. She plans to close up shop and move away before the next typhoon season.

"We get flooded every year and the waters are getting higher and higher. There is no end to it!" she complained.

Much of the waste disposed of during the clean-up still remains uncollected in the streets.

Overall, the typhoon affected over 300,000 people in the county, caused more than 90 roads to collapse, and

Damage from Typhoon Megi is still evident months after the floodwaters subsided

damaged 116,175 mu (78 square kilometres) of crops. Total losses were one billion yuan (US$150 million).

Unpredictable weather

"This year was really strange," says Liu Feng, deputy head of the county's meteorological bureau. "In a normal year a typhoon making landfall in southern Fujian wouldn't have much impact here due to the distance. We hadn't expected such a huge and concentrated downpour."

Normally the high water mark from flooding is less than one metre high. Now it's the height of a single storey building.

Over the last decade the hardware store run by Liu Nan (not his real name) has moved four times, always to higher ground. "We can't let our metal goods get wet, so we have to move them higher up," he says.

His store now sits at the highest point in the township. "Previous floods wouldn't have got this far," he says. But this year the floodwaters were high enough to flood his shop, too.

Li Qiwu, a local housing official, blames the flooding on the county's location and the frequent and intense precipitation from extreme weather events. As for the cause of the freak downpours, experts agree that climate change is a major driver.

Zhang Jianyun, head of the Nanjing Hydraulic Research Institute and a member of the Chinese Academy of Engineering, says global warming is accelerating the water cycle, increasing evaporation from oceans and causing the atmosphere to become moister.

Liu Feng explains that moist, warm air is less stable and so more likely to give rise to downpours. More moisture also means heavier rainfall.

Another factor is the very strong El Niño effect, which lasted from 2014 to May 2016. "The unusual typhoon activity of the latter half of 2016 were consequences of the El Niño effect still playing out," says Liu Feng.

The first half of 2016 saw record-breaking high temperatures around the world. "Decades-long climate trends are reaching new climaxes, fuelled by the strong 2015 and 2016 El Niño patterns," said Petteri Taalas, secretary general of the World Meteorological Organization.

A vulnerable town

Residents in towns such as Shuitou are already accustomed to regular flooding. Most buildings have a first floor that is three to four metres high, with an upper floor, too. "That's our special way of doing things here, if the floods get too high you can wait it out on the upper floor," explains Liu Fang.

Kitchens are almost never placed on the ground floor either. "In a flood the things you can't move, like the extractor hood and the oven, get soaked," adds Liu Fang.

Although buildings have long been adapted to small scale flood events, land use planning needs to catch up.

"There have been more downpours and extreme weather events these past years, and it's no longer appropriate to just keep expanding the town," says Li Qiwu, the local building official.

Liu Jidong, head of the water management authorities for the county, admits that flood prevention measures are weak. Although towns such as Shuitou and Mabu can cope with average floods, they are unprepared for 1-in-20 year events where rainfall is higher than average. "There's been too little investment. It's a historical problem," he explains.

The waterways between Shuitou and the River Ao have low embankments or none at all and often flood if rainfall is above average.

In places like Shuitou and Mabu, poor land use management has left the landscape less resilient to flooding. Waterways have been filled in to provide land for buildings, leaving less drainage for floodwaters.

The leather industry is an important part of Shuitou's economy but many factories have been built in the flood zone. Areas of land that were not supposed to be developed so that floodwaters could disperse have shrunk by 2.1 square kilometres. These are now home to residential and factory buildings.

"There's not even a decent river left. It's all been filled in," says Feng Li, head of the Pingyang flood prevention office.

"They even built a middle school on the embankment."

Xie Zuoxing, a local government official responsible for enforcing planning regulations, says that flooding wasn't such an issue in the past. "As it wasn't a problem, nobody was worried about solving it. The county bosses aren't willing to spend money on something that is not a problem yet. Urban development has been much more focused on stimulating the economy."

Planning for climate change

Since the 1990s, extreme weather events have cost China 200 billion yuan (US$30 billion) a year on average.

Zou Tao, head of the Ecological City Institute at Tsinghua University, says that urban planning needs to account for the greater frequency of extreme weather events and be able to cope with catastrophic "low probability events."

In recent years, a number of high-level plans and strategies have been released to guide action on the problem. The Action Plan for Urban Adaptation to Climate Change, an agreement published in early 2016 by China's National Development and Reform Commission (NDRC) and the Ministry of Housing and Urban-Rural Development, calls on China's cities to improve adaptation to climate through improved urban planning and better use of data.

In August 2016 the NDRC and the Ministry of Housing announced trials of climate-adapted urban construction in which 30 Chinese cities will participate.

China's 12th Five-Year Plan also called for better adaptation planning. In November 2013, nine bodies, including the NDRC, ministries of Finance and Housing, and the Chinese Meteorology Administration, published the State Climate Change Adaptation Strategy.

An official with the NRDC's climate change department, who contributed to the strategy, said that adaptation planning requires a systemic approach: "It needs to be considered in accordance with a range of fields; air and water policy, for example, involve adaptation."

This requires cross-departmental cooperation and effective action across all levels of government.

As an example, Liu Feng points to the method for assessing climate risk for major urban projects published by the China Meteorology Administration in 2009.

"It was difficult to implement it at the local level because the order to use it was distributed among the meteorology authorities. As a county level bureau we can make suggestions and requests but we can't force other departments to cooperate."

When Liu Feng's bureau suggested carrying out a climate risk assessment for a local wind farm in 2016, a large project that was important for electricity provision, there was no response.

Shao Yisheng, deputy head of the China Academy of Urban Planning and Design, says that climate change should be given greater weight in planning processes. As of 2015, the urban population accounted for 56.1% of China's total population, or 770 million people.

He says that preparing Chinese cities for climate change impacts will require research into climate-change ready technical standards, better management systems, and more capability to adapt to and cope with extreme weather events.

In Pingyang, the need to mitigate climate change by reducing carbon emissions is discussed but the conversation on climate change adaptation remains unfamiliar for most government departments.

According to a local official in Pingyang, county leaders said in meetings after Typhoon Megi that they wanted to see flood prevention measures to cope with 1-in-50 year floods, much to the discomfort of the officials responsible. But Megi has shown that the risk of extreme weather events cannot be ignored.

Facing the prospect of similar floods in future, Maomao and her family have opted to leave the place they've lived for decades. But many people are staying. While local government must take the lead in adapting to climate change, this is also a process of raising awareness throughout society. In the words of the NDRC official, "the public's attitude is also very important."

He Linlin is a reporter at China Youth Daily.

气候变化考验香港防洪系统

面对气候变化导致的越来越频繁的洪涝灾害，香港需要升级自己庞大精湛的地下排水系统。

□ 常思颖

香港年降水量多达3000毫米，是环太平洋地区最湿润的城市之一。雨季在每年五月到来，在接下来的五个月中，这个人口稠密的城市每个月都会迎来超过300毫米的降雨，雨雾令居民狭小房间的瓷砖和窗棂都覆上水珠。

雨水也带来了洪水和山体滑坡，尤其是在台风或暴雨肆虐时，而香港每年都要经历十次以上这种天气。预计未来此类极端天气将更为频繁，强度也更大。虽然香港有着堪称世界上最完善的地下排水系统，但为应对未来风险，香港正在对这一系统进行强化。

排水系统：城市的地下根系

香港庞大的地下管道和蓄水池网络可以保护城市免受水灾之患。香港渠务署（DSD）地面排水处高级工程师梁华明（音）解释说，香港的防洪系统由三套主要系统组成，设计能力可防御200年一遇的洪水。

在地势高的马路、人行道和鳞次栉比的混凝土建筑下面，埋着4条直径5到7米的排水管道。这些管道疏解了地势高地区的地表降水，避免雨水顺着地势流向低洼地区，并将这部分雨水收集利用，或者排入大海。

中间地势是人口最稠密的地区，这些地区的地下有3个收集暴雨的蓄水池。西九龙大坑东的地下蓄水池是其中最大的，深度超过10米，可储存超过10万立方米降水，相当于40个标准游泳池的水量。

跑马地马场地下的蓄水池仍在建设中，2018年建成之后将具备6万立方米的蓄水能力，足以处理总面积达130公顷的湾仔、铜锣湾和跑马地的降水，甚至可以承受50年一遇的极端降水冲击。

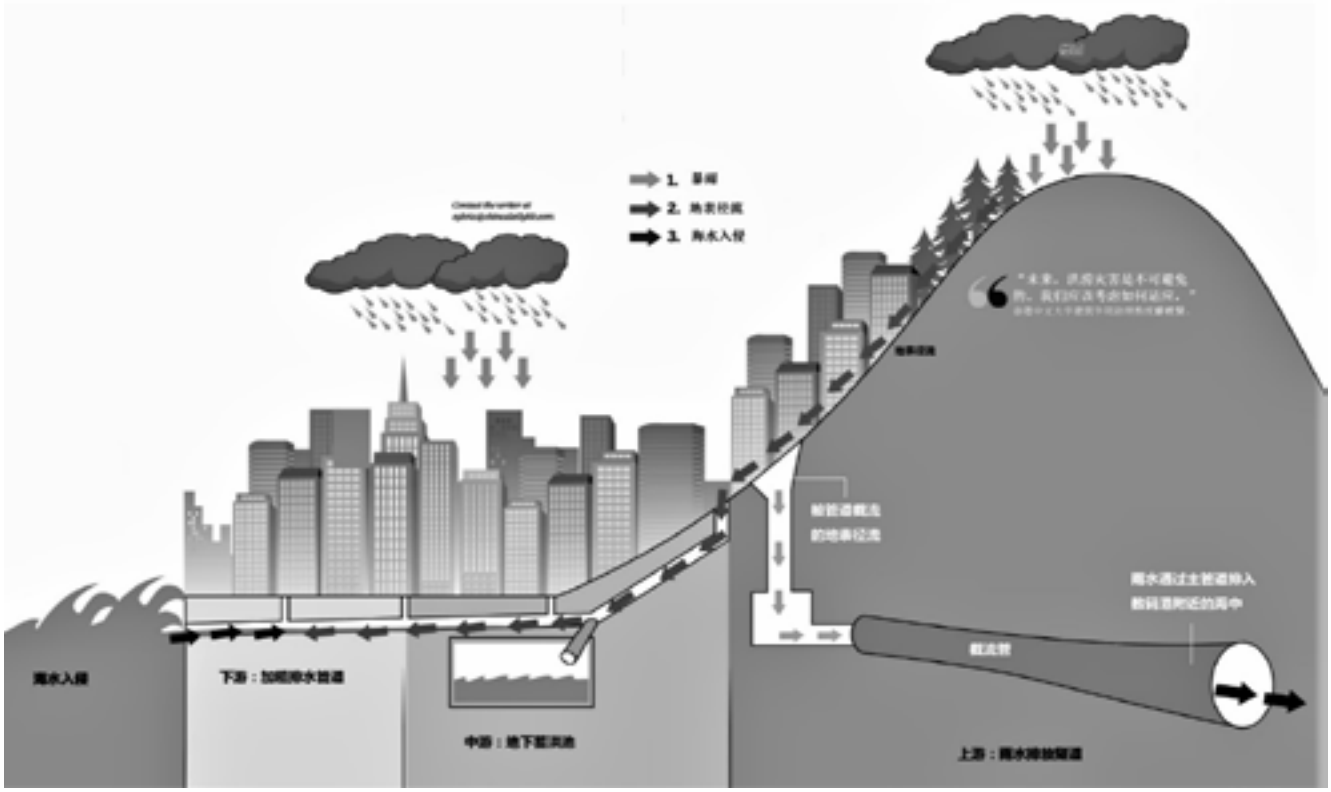
蓄水池安装了水位探测装置，并设有暗渠和验潮仪，根据水流和潮量的实时数据自动运行。当降水强度低时，蓄水池闸门紧闭，降水沿暗渠排走。当降水强度大时，闸门打开，使过多的暴雨降水流入蓄水池暂时储存。暴雨过后，排出池中蓄水，难以排放的蓄水则通过排水泵排出。

在城市的低洼地带和乡村地区，加粗排水管道，并疏通拉直下水道，形成了长达360公里的排水网络——相当于从华盛顿特区到纽约之间的距离。

地下世界宛若一个混凝土筑成的植物根系，维护着地表城市的健康和长远发展。1700公里的下水道和2300公里的泄洪渠遍布香港全城。根据DSD的介绍，全部主要的防洪“盲点”都得到了解决，风险等级不同的各类危险点的数量已经从1995年的90个减少至今年的8个。

> “1700公里的下水道和2300公里的泄洪渠遍布香港全城。全部主要的防洪“盲点”都得到了解决，风险等级不同的各类危险点的数量已经从1995年的90个减少至今年的8个。”

香港如何管理暴雨



气候变化加剧带来挑战

然而，梁华明表示，即便香港已经有了世界级的排水网络，但在气候变化的背景下，极端气候事件的增多还是给香港带来了巨大的挑战。

香港天文台的数据显示，近年来香港降水量不断突破记录。从 19 世纪 80 年代到 20 世纪 70 年代，每小时雨量的最高纪录平均能够保持 40 年。20 世纪 70 年代到 20 世纪 90 年代，这一纪录平均能够保持不到 20 年。而 20 世纪 90 年代到 2014 年间，这一纪录则每 10 年就被打破一次。

“这意味着气候变化确实在加速。”梁华明表示。

根据 2015 年 11 月发布的香港气候变化报告，极端湿润年份的数量预计将从 1885 年到 2005 年之间的 3 个增长到 2006 年到 2100 年之间的 12 个。梁华明表示，DSD 正在结合联合国政府间气候变化专门委员会（IPCC）和香港天文台的数据，重新评估香港的防洪系统。

“目前蓄水池和泄洪管道的能力难以应对未来更大的降水。再加上土地用途的变更，以及新的城市设计，我们需要对现有系统进行升级换代。”梁华明表示。

山体滑坡和杂物淤塞排洪渠

2016 年 10 月 19 日，“黑色”暴雨预警发布。这是 1998 年暴雨预警系统启动以来首次在十月份发布“黑色”预警。

香港天文台表示，每小时降水量可能超过 100 毫米，远远高于 70 毫米的黑色预警门槛。当日总降水量达到 223 毫米。考虑到香港年降水量不过在 1400 毫米到 3000 毫米之间（依区域不同而有所差异），这一降水量确实十分惊人。

暴雨突然而至，造成 14 个地区发生洪涝。香港大学土木工程系副教授陈骥指出，洪水混浊并呈现黏土的颜色。陈教授认为，这与 6 年前造成山体滑坡和排水道淤塞的强降水情况相似，是历史重演。

“香港未来防洪工作——特别是受到气候变化威胁的市区——需要考虑的最重要的一点，就是如何避免山体滑坡和杂物造成的排水系统阻塞而引发的洪涝。”陈教授表示。

DSD 的初步研究发现证实了陈

教授的判断。11 月 23 日，香港发展局局长陈茂波在回答立法会质询时说：“大量被强风刮掉的树枝和树叶堆积在上游的山坡上。10 月 19 日的暴雨将这些东西冲刷进下游的滤污器和排水系统，造成排水系统阻塞，导致系统的整体防洪能力下降。”

针对这一问题的进一步调查和解决方案还在审议之中。DSD 的梁华明说：“我们需要关于降水时间和降水量的详细数据，还需要测试类似的情况是否会再次发生。”

气候变化加大灾害预测难度

目前，指导暴雨排洪系统规划和设计的现有防洪标准的主要问题在于，它们是以历史数据为基础建立起来的。

“由于气候变化乃至自然系统存在不确定性，降水的频度和强度难以预测。200 年一遇的暴雨可能会变成百年一遇或者 50 年一遇。”陈教授说。

暴雨通常在 5 月到 9 月之间光临香港，但去年在通常是旱季的十月份却接连碰上台风和强降水。陈教授解释说，这种反常的天气是受拉尼娜效应的强烈影响。拉尼娜效应是一种气候现象，它增加了热带飓风的数量，并造成香港高于平均值的降水。

陈教授认为，在气候变化的影响下，这种现象可能会更加频繁发生。“因此必须提高旱季强降水预测的准确度，帮助 DSD 更好地采取一切预防措施，减轻洪涝灾害的影响。”

一方面，科学家正在研究提升洪涝预报准确度的方法，而另一方面，建筑专家也开始将洪涝灾害作为建筑设计中的常规假设条件。

与洪灾共生

“未来，洪涝灾害是不可避免的。我们应该考虑如何适应，”香港中文大学建筑学院助理教授廖桂贤表示。解决的办法在于设计出可涝区域，保证公共区域特别是城区公共区域的多功能性，在强降水发生时可以储水。

廖教授认为，洪涝是正常现象，因此城市规划者和建筑师应该致力于减轻洪水险情的应对工作，降低其对人类的威胁并避免可能对居民安全和经济发展造成重大伤害。

廖教授认为，“增加城市防洪能力、避免洪水险情发展成为洪涝灾害”是十分重要的，而城市的防洪能力意味着被淹之后可以迅速恢复。

“我们将生活在一个洪涝频发的环境当中。所以我们只能顺其自然，尽力适应。”廖说。

常思颖，《中国日报》亚洲版的记者

地下排水管道总体规划一览	
地区	状态
1.元朗区	完工
2. 北区	
3. 跑马地	
4. 西九龙	
5. 东九龙	
6. 大埔	在建
7. 沙田&西贡	
8. 港岛北部	
9.大屿山& 离岛	
10. 荃湾、屯门及青衣岛	规划
11. 将军澳	
12. 港岛南区	
资料来源：香港渠务署	

Bracing for the flood in Hong Kong

Hong Kong is striving to adapt to a changing climate and the increased risk of flooding

□ Sylvia Chang

The number of extremely wet years is expected to quadruple in Hong Kong over the next century

With up to 3,000 millimetres of annual rainfall, Hong Kong is one of the wettest cities in the Pacific Rim. The rains come in May with fog and mist blanketing the ceramic tiles and window frames of the city's shoebox homes, soaking the densely packed city for the following five months.

Flooding and landslides are a major risk, particularly during typhoons and torrential rains, which happen at least ten times a year. Such extreme weather events are expected to become more frequent and of greater intensity in future. To prepare, the city is improving what is already one of the world's most developed underground drainage systems. However, because climate change is making existing weather data and models redundant, planning new drainage infrastructure is especially challenging because the frequency and intensity of storms and floods cannot be accurately predicted.

Concrete roots

When it pours in Hong Kong the city is protected from

flooding by a large network of underground tunnels and storage tanks. Richard Leung Wah-ming, senior engineer at the Land Drainage Division of the Drainage Services Department (DSD), explains that the city's flood control system has three major systems designed to protect it from events that happen once every 200 years.

Stretching beneath the city's roads, pavements and crowded concrete buildings are four rain tunnels, each 5-7 metres in diameter, nestled into the mountain slopes. These tunnels divert heavy rainfall on the upland surface away from low-lying areas downstream. The waters are collected and reused in the city's water system or drained into the sea.

Where population density is higher (in the "Mid Level"), three underground storm-water storage tanks collect rainwater. The largest, at Tai Hang Tung in West Kowloon, is over 10-metres deep and can hold 100,000 cubic metres of storm water, equivalent to about 40 standard swimming pools.

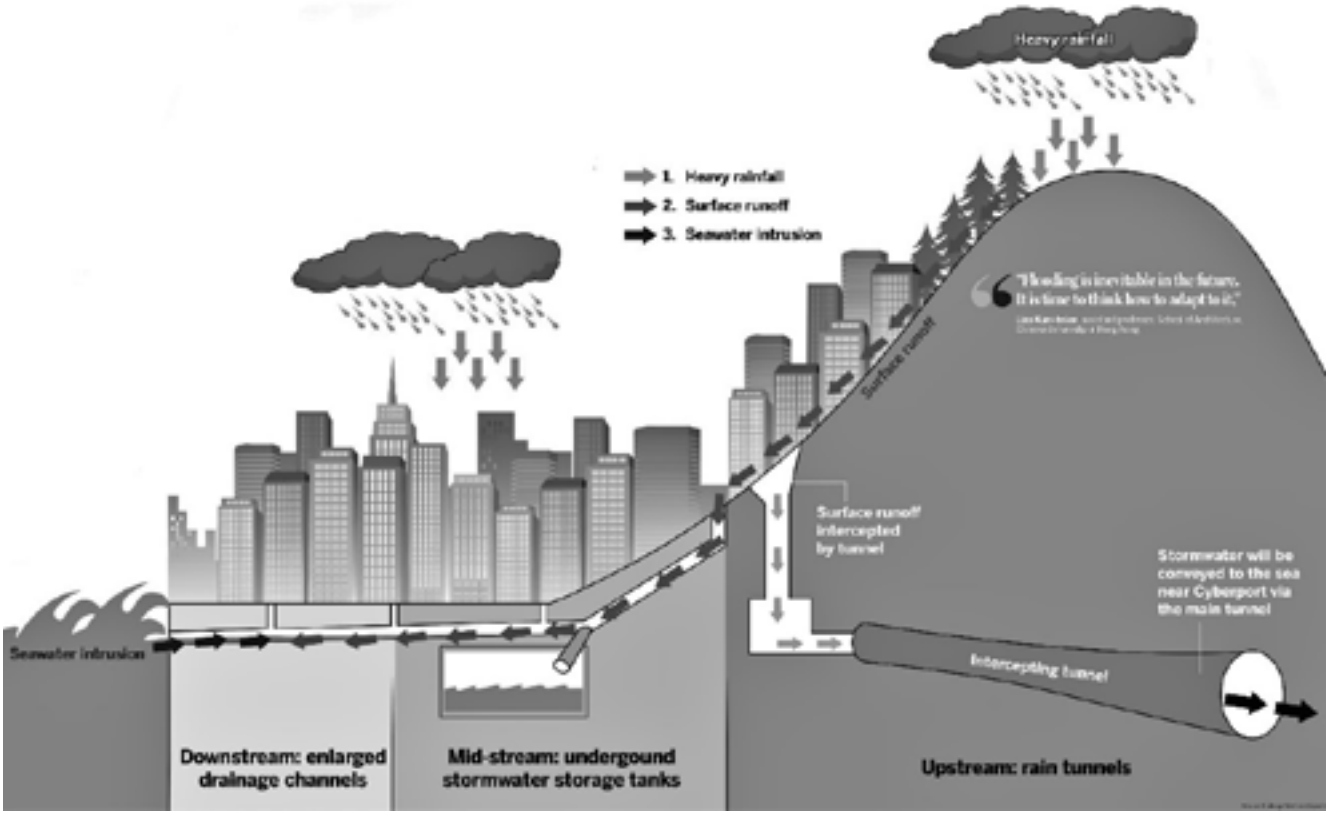
The storage tank beneath the Happy Valley racecourse is still under construction but once it's completed in 2018, it will have a capacity of 60,000 cubic metres, enough to drain the 130 hectares of Wan Chai, Causeway Bay and Happy Valley, even in a 1-in-50 year weather event.

The storage tanks contain water level sensors, culverts and tide gauges that operate automatically based on real-time data of water flow and tidal levels. When the rainfall intensity is low, the weirs of the tank are kept closed and storm-water flows along the culvert.

When it rains heavily, the weirs lower to allow storm water to overflow into the tank for temporary storage. After the flood has passed, the weirs are lowered further to allow the stored water to flow back, while the remaining storm water is pumped out.

At the lower levels of the city and in rural areas, drainage channels have been enlarged and dredge sewers straightened, stretching out in a web 360 kilometres long – equivalent to the distance from Washington, DC to New York.

How Hong Kong manages heavy rainfall



This underground concrete root system is meant to maintain the health and longevity of the city above ground. The sewers and storm-water drains extend as far as 1,700 kilometres and 2,300 kilometres, respectively. All major flood "blackspots" have been neutralised, and the number of danger points, posing varying degrees of risk, have been reduced from 90 in 1995 to just eight this year, according to the DSD.

Accelerating climate change

Even with its "world-class system", Leung said that climate change poses a major challenge as extreme weather events increase.

Data from the Hong Kong Observatory shows that rainfall records are regularly broken. Previously, the maximum hourly precipitation record in the period between the 1880s and the late 1970s would stand for 40 years on average. This has fallen to less than 20 years between the late 1970s and the 1990s. From the 1990s to 2014, the records were broken every ten years.

"Climate change is really accelerating," said Leung.

According to the Hong Kong climate change report released in November 2015, the number of extremely wet years is expected to quadruple, from three during 1885 to 2005 to about 12 from 2006 to 2100. Leung said the DSD is using the combined data from the Intergovernmental Panel on Climate Change (IPCC) under the United Nations, and the Hong Kong Observatory to review Hong Kong's flood prevention system.

"The capacities of the current rainstorm tanks and channels may not be able to hold heavy rainstorms in the future. Together with the changing land use and new urban design, we need to update the current systems," Leung said.

> "While scientists are working on ways to improve the accuracy of flood forecasting, architects are beginning to work on the assumption that flooding will happen regardless."

Landslides and debris

"The most significant thing to consider for the future of flood prevention in Hong Kong, especially in urban areas threatened by climate change, is how to prevent floods caused by landslides and debris that leads to blockage of drainage systems," said Chen Ji, associate professor at the Department of Civil Engineering at the University of Hong Kong (HKU).

On October 19, 2016, a "black" rainstorm warning was issued; the first during an October since the warning system was put in place in 1998.

The Hong Kong Observatory said the hourly rainfall exceeded 100 millimetres, far above the threshold of 70 millimetres for the black warning. The day's total rainfall reached 223 millimetres. This is remarkable given that annual rainfall in the city is between 1,400 and 3,000 millimetres, depending on the district.

The downpour struck suddenly and caused floods in 14 areas. The waters were muddy and clay-coloured. This was history repeating itself, said Chen, recalling that heavy rainfall and floods six years earlier had resulted in a landslide that blocked the drainage system. Preliminary findings by the DSD confirmed that blocked drains cause major damage.

Responding to the Legislative Council on November 23, 2016, Secretary for Development Paul Chan Mo-po said, "[Tree branches and leaves] were washed down into the catch basins and storm-water drainage systems downstream by the severe rainstorm on October 19, resulting in blockage of the drainage systems, and hence undermining the overall flood-relieving capacities." Further inspections and practical solutions to the problem are under review.

Problem forecasts

The problem with existing flood prevention standards that

guide the planning and design of storm-water drainage systems is that they're based on analysis of historical data. "Due to the uncertainty of climate change, or even the natural system, the frequency and intensity of rainfall are hard to predict. It is highly possible that a 1-in-200 year rainstorm could become a 1-in-100 or 1-in-50 year event," Chen said.

Rainstorms usually strike Hong Kong between May and September but last year there were successive typhoons and heavy rainfall in October, which is normally a dry month. This abnormal weather, Chen explained, was due to a strong occurrence of La Niña, an atmospheric phenomenon that increased the number of tropical cyclones and brought above-average rainfall to Hong Kong.

It is possible this phenomenon could become more frequent under the impact of climate change, Chen said. "So it is important to enhance the accuracy of seasonal forecasting of heavy rainfall in the dry season so that the DSD can take all precautions to mitigate the impact of floods."

Living with floods

While scientists are working on ways to improve the accuracy of flood forecasting, architects are beginning to work on the assumption that flooding will happen regardless.

"Flooding is inevitable in the future. It is time to think about how to adapt to it," said Liao Kuei-Hsien, assistant professor in the School of Architecture of the Chinese University of Hong Kong.

The solution is to design areas that are floodable and ensure that public space, especially in urban areas, is multi-functional so it can be used at times of heavy rain to store water. Flooding is a natural phenomenon argues Liao so city planners and architects should be focused on reducing flood hazards, the threat of flooding to human beings, and flood disasters, which cause damage to residents and the economy. It is important "to increase the resilience of the city and to prevent flood hazards from becoming flood disasters," said Liao, explaining that resilience means a flooded city can recover quickly.

"We'll be living in an environment where flooding is natural. So we need to get used to it. Just let it flood."

Sylvia Chang is a reporter at the China Daily Asia edition.

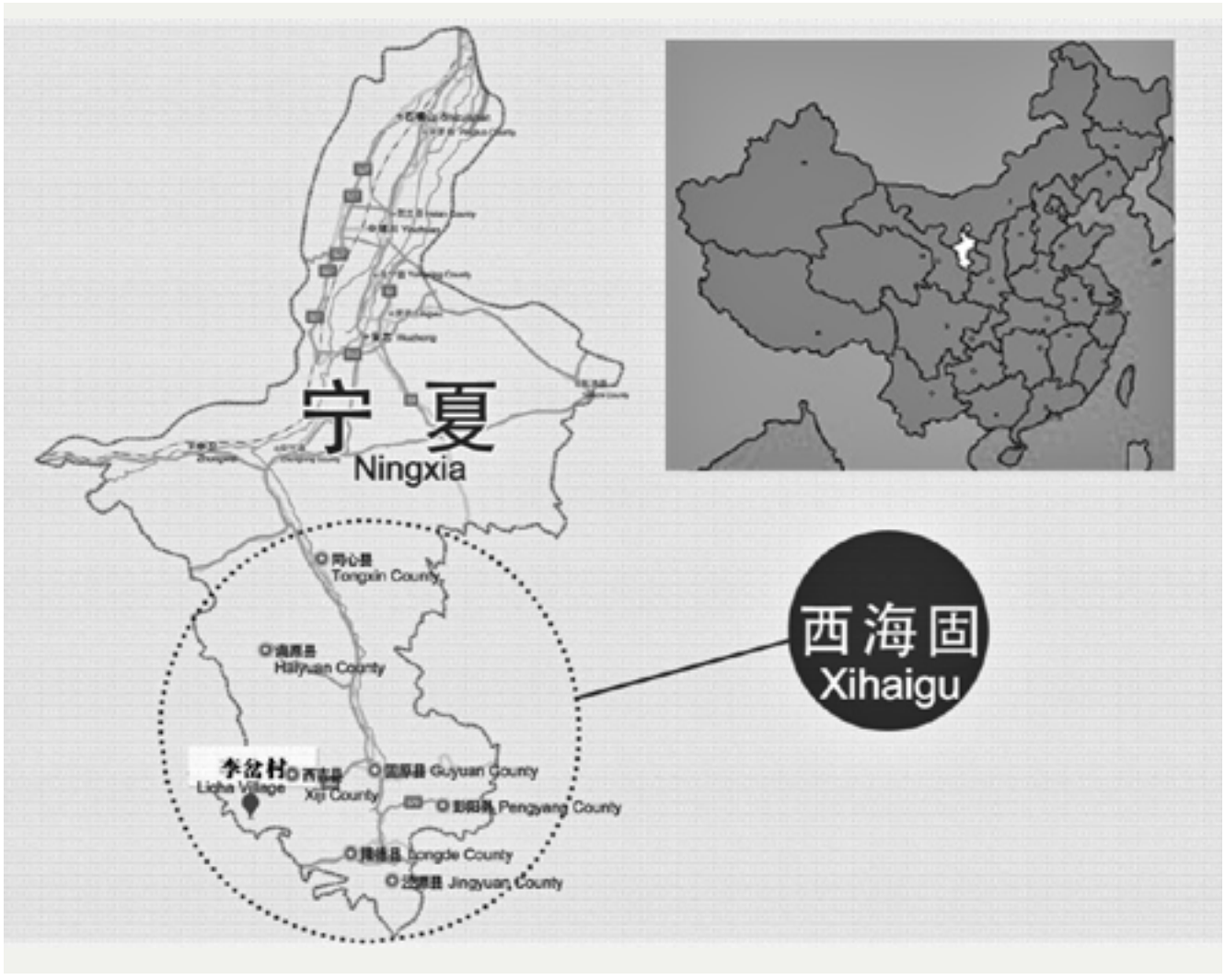
宁夏西海固：适应水困

气候变化迫使人们从中国西北的偏远村庄搬迁到设施良好但工作机会少的新城镇。

□ 康 宁

从宁夏首府银川出发，沿着京藏高速驱车向南驶进，颜色逐渐加深的黄土地出现在车窗外。地头远端肃静的山脉下，时不时巨大的沟壑唐突地出现，将平坦的田埂割裂开来。有时，河谷上出现一座现代化的桥梁，但远眺深陷的河床，却寻不着流水的踪迹。田地里，偶尔出现懒散的牧人蹲坐在一旁，守望着一群正在啃食荒草的羊。

那里便是西海固，一个在中国地图上找不到的名字，原是宁夏回



族自治区中南部西吉、海原、同心、原州、隆德、泾源、彭阳七个国家级贫困县的统称。它是西北地区最为贫瘠的干旱地之一。因深陷内陆而导致水汽难以到达，加上温带大陆性半干旱气候和水源奇缺的自然条件，西海固大部分地区生存条件极差。

近年来，全球气候变化正在加剧西海固人对水的担忧。虽然随着中国社会经济的快速发展和中央政府多年来逐步加大的扶贫力度，如今的西海固早已不是人们刻板印象中“苦瘠甲天下”的黄土坡，但如何适应水困仍是令人忧心的事情。

缺水之忧

13 岁的马莉娜家住在西吉平峰镇的李岔村。这个村子深陷在西海固黄土高原的丘陵沟壑地带。对于她和她的家人来说，近年异常的天气，似乎正在成为西海固的新常态。

这些年，西海固地区的降水普遍呈减少趋势。据西吉县气象局统计，2016 年 1 至 7 月份，西吉县的一些地区降雨量较常年同期偏少 6.9% 至 17.5% 不等。这一年 8 月中上旬，气温达到了 1961 年以来最高值，而降水却为同期最低，局地出现了大旱。为此，当地政府不得不采取了人工降雨的方式来补给降水。异常的天气使当年马铃薯减产了 10%。

中国农业科学院研究员许吟隆就曾在接受媒体采访时解释：“气候变暖不管在中国还是全球，都会导致未来降水总量增加，因为大气变暖后加剧水循环。但是水的空间、时间分布更加不均匀，加剧旱涝灾害。由于气温升高导致地面水汽蒸发加剧，干旱将变得更加严重。”

如果将西吉县气温和降水的变化放到更长的时间维度来看，这种气候暖干化的确正在以惊人的速度加剧黄土高原的干旱缺水。自 20 世纪 70 年代末到 21 世纪初，西吉的年平均气温升高了 1 摄氏度之多。1950 至 2000 年，这里的年均降水量却减少了 100 毫米左右。

经过科学家多年的研究论证，气候暖干化已经使黄土高原的土壤干层分布变广，干层缺水更加严重。这将是对农作物产量最致命的影响。

“今年没下什么雨，地里收的马铃薯个头都只有拳头大。”马莉娜站在自家的田里，比划道。马铃薯是促进西吉县域经济发展的支柱产业，在李岔村，村民除了种植胡麻、小秋杂粮以外，地里最主要的农作物便是小麦和马铃薯。

马莉娜的父亲马继峰告诉记者，他家十几亩地的马铃薯往年不仅能带来一万多元的收入，还能保住一家人一年主要的口粮。但今年，气候异常导致马铃薯的成品不好，价格被压到只剩四角五分一斤。

马莉娜的同班同学安晓康和她住在同一个村子，是一起长大的玩伴。安晓康回忆起，村里的深沟里原本流淌着一条小河，自己前年夏天还在这捉过蝌蚪，但现在站在田埂边缘，他俯下身望去，在干涸的河床上，却已经遍寻不着水的踪影。

> “气候暖干化已经使黄土高原的土壤干层分布变广，干层缺水更加严重。这将是对农作物产量最致命的影响。”

马莉娜和安晓康家所在的高山庄在这条沟谷东面的山坡，在这里打井，取到的水非咸即苦，很难见清泉。据西吉县水务局的调查，当地的地下水溶解性总固体和硫酸盐超过了国家生活饮用水标准的数倍。事实上，西吉县内的水库也多是不能供人饮用的“咸水”。

“以前村子附近有好几个这样的泉眼，但现在少见了，这里的水也变少了。”安晓康注视着从自己身旁经过，赶去喝水的牛群，若有所思地说道。

存水、找水、引水

给炕添完牛粪回到屋子，马莉娜往脸盆里倒上了刚没过盆底的水，洗了洗手。在她家放置脸盆的木架旁，摆着一只储水的塑料桶，家人会把用过的水倒进去，兴许这还有别的用途。长期缺水让这里的人更懂得水来之不易。

马莉娜家的日常生活用水需去老屋门前的水窖里挑。储蓄降雨来抵御干旱的日子是当地人十多年来赖以生存的办法。她家老屋的门旁有个半米长宽的蓄水池，一头连接通往屋内的水槽，一头连着水窖。每到雨天，地面和屋顶的雨水会顺水槽水槽流入水窖，储存起来供人畜使用。

在黄土高原干旱地区，国家曾为推广这种家庭集雨工程提供了充足的财政支持，政府出钱帮助村民

修建水窖。打开水窖的盖，里面是沉淀后清澈的水。马莉娜家的水窖能存二十立方水，除此之外，她家还有一口专供牲口用的三十立方米水窖和一口地里的水窖。在外人眼中，三口水窖让这个生活在水资源匮乏地区的家庭显得颇为富裕。

2015 年，安晓康的爷爷安建华给一部分种马铃薯的地里蒙上了塑料膜。即使雨水少了些，那些蒙上了膜的地里收获的马铃薯个头也还可观。安建华想象着，如果能有更先进的引水方式，能把平日储下来的水引到山上，一层层地灌溉梯田，那该有多好。又或者是，发展更适合的果树或者药材种植。

宁夏大学资源环境学院戴海龙在研究气候变化对西吉县农户生计影响的论文中提及，当地“应扩大种植抗旱性强、水分利用效率高的农作物，增强农作物对缺水的适应能力，加大秋季作物的种植面积。”合理的农业布局，科学的专业指导，或许能给劳作在干旱田地里的西海固人带来多一点的收成。

西海固流传着一些关于龙王唤雨的神话传说。安晓康回忆起小时候听村里老人们说的神话，“离李岔村二十公里的震湖里住着能呼风唤雨的白色蛟龙。”因此，旧时一些当地人遇到大旱天，总不忘祈求龙王能施恩降雨。有足够的生活用水是西海固人世代的奢望。

现在，李岔村家家户户的院门口都立着一个自来水龙头，水管旁压着一块刻着“宁夏西吉县城乡供水公司”的井盖。据村民介绍，为此每户人家向村政府交纳了 500 元钱。水管已经安上许久，村民却没能用上自来水。李岔村的一位村官解释，

> 马莉娜家的水窖能存二十立方水，除此之外，她家还有一口专供牲口用的三十立方米水窖和一口地里的水窖。在外人眼中，三口水窖让这个生活在水资源匮乏地区的家庭显得颇为富裕。

通水计划深入山区的主体工程都已完工，但地势复杂，仍有需要完善的地方，才能实现全面通水。

这位村官口中的“工程”指的是宁夏中南部城乡饮水安全工程，耗资 40 亿元。2016 年 10 月 8 日，宁夏自治区政府在西吉毗邻的原州区举行了盛大的庆典仪式，宣告这项工程建成通水。

西吉县水利局饮水办的官员告诉记者，至今李岔村未能通水的原因很复杂，其中之一是由于 2016 年县区整体干旱少雨导致中庄水库迟迟未能蓄足水量，就目前情况来看，仅供城区的蓄水都并不充足。他所提及的中庄水库正是耗资 2.3 亿修建的一座主调节水库，也是实现和保障宁夏中南部城乡饮水安全水源工程正常供水的“核心咽喉”工程。

将甘甜的泾河水引来缺水的西吉县，通过水资源的空间调配可以解决干旱地区暂时的水困。对于李岔村的村民来说，“南水北调”进山区值得期待，只是农户院落前除了管道和蒙着灰层的水龙头，始终未见有自来水流出。

安建华觉得自己有足够的耐心等待水来。倘若十年前，当地人绝不敢相信有一天城里人才能用上的自来水会来到这片山角旮旯。

把人搬走

除了引水工程之外，当地也试图恢复自然的调节力。近十几年来，宁夏自治区政府强制执行退耕还林使部分植被得以恢复，生态修复工程逐渐改变了黄土坡的面貌。

2003 年 5 月 1 日，宁夏回族自治区开始在全境推行封山禁牧，成为全国首个实行全境封山禁牧的省区。自治区政府公布的一份数据显示，禁牧十年当地森林覆盖率由不到 10% 提高到了 12.8%，沙化土地净减少 79.5 万亩。

马莉娜从抽屉里取出一包塑胶袋裹好的照片，抽出了一张。那张照片是去年夏天在她家新房门前拍的。相比于此时屋外枯黄色的荒山，照片里存着一派郁郁葱葱的景象。“这就是夏天的样子，可好看呢！”她一手指着照片，带着骄傲的神情说道。她家对面山坡的田地里种着几十株杏树，一到夏季便绽放出翠绿的色彩。

借助自然的力量恢复生态似乎初见成效，但改变传统的生产方式并不是一件容易的事。当地的一些村民并不理解政府禁牧的用意。在偏僻的山坡上，还能瞧见放牧的人。

将人迁走也是另一种选择。历史上，宁夏自治区早在 1983 年起，就曾对西海固村民实施过四次政策性移民搬迁，腾出来的土地进行生态修复。

2011 年 5 月 6 日，宁夏自治区人民政府颁布了《宁夏“十二五”中南部生态移民的规划》。规划指出，

“包含西吉县在内的9个宁夏中南部扶贫开发重点区县处于我国半干旱黄土高原向干旱风沙区过渡的农牧交错地带，生态脆弱，自然灾害频繁，水土流失严重。由于中南部地区生态环境问题与贫困问题通常表现为相互制约、互为因果的关系，因此对生活在这一地区的农民实施搬迁，对恢复和保护生态环境具有重要的作用”。

因为这项生态移民政策，西吉县一些村庄的村民搬迁到了宁夏北部靠近水源的地方生活。人走后，田地荒了，漫过成年人小腿肚的荒草在地里肆意生长。一些废弃多年的院落，已经长满了灌丛。

相较而言，李岔村7.5平方公里面积，拥有耕地近5平方公里，地广人稀，加上基础设施相对齐全，所以，李岔村并没有出现在宁夏自治区人民政府中南部生态移民的清单中。

故土难离

李岔村的人想离开却走不了，但有的人能迁走，却不曾离开。

为了落实“生态移民”政策，让村民尽快搬走，政府会在期限到达的时候把他们的房子推倒。宁夏移民局的一位官员曾在接受媒体采访时表示，拆房子是为了不让村民两头摇摆，一些移民在迁出地和迁入地两头生活，给人口管理和生态修复都带来了困难。

生活在另一个村子的李有福就是这样的人。他家生活的庄子被列在官方搬迁清单上。现在除了他家的院落，庄子其他的土屋都已经破败不堪，有些被削去了屋顶，只留下断壁残垣。

李有福告诉记者，除了他和老伴，如今邻里乡亲都搬去了政府规划的移民村，往常没有人会再来这里。

“人总有份故土情，不愿离开的。”李有福摩搓着布满茧子的双手，面露尴尬，有些拘谨地说道。关于为什么不搬走这件事，他不愿解释过多。

即使留下来生活孤独清淡了些，离开却需要更大的决心。李有福的老伴坐在一旁的土炕上，皱着眉头小声嘀咕着：“我都没去过那个新村，坐不得车，那离家太远了。”

她所指的新村是位于银川市贺兰县的欣荣村，老两口的邻居如今都生活在那里，他们不再种地和喂养牲口，过上了另一种截然不同的生活。

新的生活

从银川市北边出城驱车40分钟，穿过一片平整的水田，就能到达贺兰县洪广镇的欣荣村。社区四四方方铺陈开来，整齐划一的平房，统一的白墙蓝顶，街道上每隔十米是一盏太阳能路灯，文化广场上布置了健身器材。除了门牌号便于区分，每间院落几乎有一样的外观。

住在三区的马艳梅，一家人从西吉县搬来欣荣村已经三年多了。当时，七口人迁来，他们领到了一套54平方米二室一厅的房子。

> “在一家水果摊前，一位中年男子坐在货架边抱怨：“以前种四十亩地，养不少牲口，现在却只能守着破摊子，什么也干不了。”

屋子的客厅不大，地板铺上了乳白色的瓷砖。屋内除了沙发、茶几、电视这些必备品，靠里的墙壁上还装上了烧煤气的暖气管，墙上安装着净水器。马艳梅形容自己是“过着城里人生活的农村人”。

“这里交通方便，吃水方便。”马艳梅对新的生活还算满意，她已经很久没有回过老家了，亲戚邻里也都搬来了这里。比起靠水窖生活，通到家里的自来水方便许多。她家的院子里摆放着一台双筒半自动洗衣机，旁边放着一盆刚洗好的衣物。每家平房的屋顶上都摆放着一台太阳能热水器，她说：“在这洗澡很方便”。

参与生态移民计划的村民有些没有分到田地。在欣荣村的文化广场附近，几家小摊贩支着货架，在售卖水果、干果和日常用品。两排门面房开着各式小店，店主多数是搬迁来的村民。在一家水果摊前，一位中年男子坐在货架边抱怨：“以前种四十亩地，养不少牲口，现在却只能守着破摊子，什么也干不了。”

马艳梅家幸运地分到了土地，总共面积不到两亩。但在西吉县的老家，她家曾经耕种着七十亩旱地，即使一年雨水不足，广种薄收也能有一家人足够的口粮。现在，政府统一将地承包给了企业规范种植，他们每年能拿到2000元左右的回报。

在欣荣村，所有的生活必需品都得花钱买，对于移民来这里的西吉人，养活一家人唯一的出路就是外出打工。据媒体报道，欣荣村目前居民1.1万余人，全部是从固原

市原州区、西吉县搬迁而来的村民，在这当中外出打工的人员近3000人。

留在西海固

现在，西海固很难看到正值壮年的青年人，留着老人在家种地、养牲口，到农忙时节有些青年人会赶回家帮忙。像马莉娜和安晓康这个年纪的孩子，在农忙的时候，都会帮家里干活。安晓康父亲因车祸瘫痪，母亲有严重的肝病，家里没有足够的劳动力，他和哥哥安晓龙在课余几乎承担了家里最累的力气活。安晓康指着探出绿色苗头的冬麦，告诉我那就是他和哥哥一起种下的。

安晓康和安晓龙的成绩离考上高中有很大差距。安建华在心里筹划着，如果哥俩考不上高中，就送安晓龙去学厨，把安晓康送去当兵。“等他们都走了，田就不种了，没人了，这山坳坳里没法种。”安建华一边抽着用稿纸刚卷好的烟，一边看着电视说道。在老一辈人的心里，这里的年轻人似乎只有走出大山才能寻到未来。

安晓康家只有院子里一口水窖。“这不是一口好窖”，窖里储的水浑浊不清，平日只用来给牲口饮用。每周，他和安晓龙离家前，都要拉一辆二轮车去李岔和潘家沟交界的泉眼运两桶50公升的水回家，作为家人一周必备的饮用水。

2016年12月24日，夜里下了一场冰粒子，安晓康觉得这不算一场雪。但天亮后，土坡路结冻后铺着还未融化的冰粒子，特别滑。第二天便是周日，是村里念中学的孩子回校的日子，也是往常安晓康和安晓龙例行帮家里拉水的日子，可是结冻的路面却让原本步行三十分钟就能抵达的取水路变得遥不可及。

如果有的选，安建华希望一家人可以搬去平坦靠近水源的地方，这样的话，等孙子们离家了，不能干重活的儿媳还能在城市边缘找到轻松的活计挣钱。他不明白生态移民项目为什么没有选中李岔村。

文章在澎湃新闻网站刊登

康宁，《澎湃新闻》记者

Life without water in Xihaigu

Climate change is forcing thousands of people to move to new towns with good facilities but few opportunities

□ Kang Ning

Drive south on the Beijing-Tibet expressway from Yinchuan, the capital of Ningxia province in China's north-west, and you'll notice the earth take on a yellowish hue. The land is cut by deep gullies from the far-off hills and crossed by modern bridges, but looking down you'll see no sign of water. In the fields, a few scattered shepherds squat, watching over their flocks of grazing sheep.

This is Xihaigu. It's not a name you'll find on a map, but a colloquial term for seven counties in the south of Ningxia. This area is home to some of the least fertile land in China's north-west.

Although economic development and years of government funding have helped to address poverty here, the semi-arid climate means that water is scarce. Climate change is making conditions even worse, leaving the population worried about how it will cope with water shortages.

Water worries

Figures from the meteorology bureau in Xiji county, Ningxia, show that between January and July 2016, rainfall was between 6.9% and 17.5% lower than the yearly average in some locations. In mid-August, the temperature hit its highest level since 1961, while rainfall saw a new low, triggering localised droughts. In response the local government created artificial rain. Potato harvests dropped by 10%.

Drought on Xiji's plateau is worsening at a frightening pace. Between the 1970s and the 2000s the average temperature increased by more than 1°C, while average annual precipitation fell by about 100mm between 1950 and 2000. This is drying out the soil on the loess plateau and hurting crop harvests.

"We didn't see much rain at all this year, and the potatoes were only as big as your fist," says Ma Lina, holding up her hand to demonstrate. She's 13 and lives with her family in the village of Licha, in Pingfeng county, deep in the loess hills and gullies.

Her father, Ma Jifeng, says their potato harvest provides an income of over 10,000 yuan (US$1,453), as well as a staple food for the family. But this year the crop was poor and prices low. Potatoes and wheat are major sources of income in the area, alongside sesame and various autumn grains.

The drought is also affecting the local water supply. Ma Lina's classmate, An Xiaokang, also lives in the village. He recalls when there was a stream in the gully running through the village. The year before last he caught tadpoles there but now there's nothing but a dry riverbed.

Nowadays, it's rare to find clean water when drilling a well, with most producing salty or bitter water. Soluble

solids and sulphates exceed permitted levels by several times according to the Xiji county water authorities. Even local reservoirs are filled with salty water.

"There used to be several good wells near the village but there are far fewer now. There's just less water in general," says An Xiaokang, watching a herd of cattle pass by on their way to drink.

Water management

With less rainfall, people in Xihaigu have grown careful to store water and reuse it. Ma Lina's family capture it from the surrounding grounds and the roof of their home and store it in cisterns. Funded by the government, Ma Lina's family have a tank for the home, another for the livestock, and one more to help irrigate their fields. In the house, there's a water bucket near the basin where grey water is poured for reuse.

Better agricultural techniques could boost the income for those labouring in the arid fields of Xihaigu. In a paper on the impact of climate change on the livelihoods of farming households in Xiji, Dai Hailong of Ningxia University's School of Resources and Environment says "planting of drought-resistant and water-efficient crops should be expanded, to better cope with water shortages. Autumn planting should also be expanded."

In 2015, An Xiaokang's grandfather, An Jianhua, started covering some of his potato fields with a protective covering. Despite lower rainfall, the potatoes grown under plastic were of a good size. An Jianhua dreams of better irrigation techniques that would let him use stored water to nourish his terraced fields, or of growing more suitable crops like fruit trees or medicinal plants.

There are myths in Xihaigu about a Jade Dragon god that can summon the rains.

"About twenty kilometres away there's a lake, Dawn Lake, and there's a white dragon there which can call up the wind and rain," says An Xiaokang, remembering tales the old folk told him when he was little. "In the past, people would pray to the Jade Dragon in times of drought. Ample water has been a luxury for generations."

Every house in Licha now has a tap outside next to an access hatch marked "Ningxia Xiji Urban-Rural Water Company". The taps are part of a four billion yuan (US$581 million) water security initiative for central and southern Ningxia. Last October, the Ningxia government held a ceremony in nearby Yuanzhou to celebrate its completion.

The taps in Licha have been in place for ages and cost households 500 yuan to install but there's still no water. A village official explains that most of the water supply project is complete but the complex terrain means further work is needed before everyone will have access.

An official with the drinking water office at the Xiji Water Bureau says that the reasons Licha remains unconnected are complicated, but one factor is that the drought has meant the Zhongzhuang reservoir has never been filled and currently is unable even to supply urban areas. The reservoir cost 230 million yuan (US$33.4 million) and is essential to supplying water for the entire project.

Bringing in fresh water from the Jing River to Xiji would help solve temporary water shortages. Villagers in Licha are also looking forward to the arrival of the South-North Water Transfer Project (a controversial scheme to pump water from the south of the country to the parched north).

It looks like the pipes and dusty taps in their front yards will remain dry for a while longer. But An Jianhua thinks that patience will pay off. Ten years ago the villagers would never have even dreamed that the water supplies that city dwellers took for granted could ever reach their remote mountain village, as the transfer project promises to do.

"Better agricultural techniques could boost the income for those labouring in the arid fields of Xihaigu."

Staying home

To ensure villagers move promptly as part of its relocation policy, the local government will knock down houses once its chosen warning period has expired. One official with the provincial relocation authority said in a media interview that this prevents the villagers spending time in both locations, which some prefer to do. This complicates the government's effort to manage the population and restore the environment.

Li Youfu, from another village, is one of those people. His village was listed for relocation but his home is now the only one left standing; the others are ruined, in some cases just roofless walls. Li says that everyone else, apart from him and his wife, moved to the new government-designated village. It is rare now for there to be visitors.

"You can't just leave where you've lived all your life," he says, awkwardly, wringing his calloused hands. He doesn't want to talk more about why he is unwilling to leave.

Even though it is lonely in Licha these days for him it would be tougher to go. His wife sits on the kang off to the side, frowning as she mutters: "I've never even been to the new place, I can't stand travelling and it's too far."

The new village is called Xinrong, in Helan county, outside the city of Yinchuan. Their former neighbours all live there now, no longer planting their fields or keeping livestock, but living entirely new lives.

New lives

Drive 40 minutes north from Yinchuan across wide expanses of paddy fields and you reach Xinrong. The community sprawls out in neat blocks of single-storey homes, all with white walls and blue tile roofs. There are solar-powered streetlights every ten metres and outdoor gyms in the squares. Apart from the house numbers, each building looks identical.

Ma Yanmei and her family moved here from Xiji three years ago, the seven of them were allocated a home of 54 square metres, with two bedrooms and one living room.

The living room is small, the floor covered with white tiles. Alongside essentials like a sofa, coffee table and television there is a coal-gas heater and water purifier. Ma describes herself as "a villager living a city life."

"Transport is convenient, it's easy to get water," says Ma. She's happy with her new life and hasn't returned to her old home for a long time as all her relatives and neighbours are here now. The running water is preferable to water stored in a cistern. Out in the yard there's a twin-tub washing machine, a basket of freshly washed clothes next to it. All the homes have solar water heaters on the roof. "It's so easy to wash here," she says.

But not all of those relocated have been allocated land. Near one of the squares in Xinrong there are several stalls set out, selling fruit, nuts and household goods, as well as two rows of various shops, most run by relocated villagers.

One middle-aged man who minds a fruit stall complains: "I used to have 40 mu (26,666 square metres) of land and a decent-sized herd, now I've got nothing but this old stall."

Ma Yanmei's family was lucky; they got some land, although less than two mu, compared to the 70 they had back in Xiji. Even if the rains were poor a harvest could provide food for the whole family. Now all that land is leased out to a commercial farm, earning them 2,000 yuan (US$290) a year.

In Xinrong all the essentials have to be bought and the only way for people relocated from Xiji to afford goods is to travel away and find work. Media reports say that there are over 11,000 residents in Xinrong, all relocated from elsewhere – and in the process of relocating, almost 3,000 opted to move away to find work.

Left behind in Xihaigu

It's rare to see young people of working age in Xihaigu nowadays. They've left the old folk behind to plant the fields and look after the cattle, maybe returning to help out with the harvest.

Children like Ma Lina and An Xiaokang also help out with the harvest. An Xiaokang's father was left paralysed after a car accident and his mother has liver disease so he

In recent decades the average temperature has increased by more than 1°C in Xihaigu and rainfall has declined, putting more pressure on an already scarce water resource

and his brother do all the physical labour after school. An Xiaokang points toward the fields of winter wheat, just starting to turn green, and tells me it was all planted by him and his brother.

The two brothers aren't doing anywhere near well enough at school though to get into senior middle school. Their grandfather has decided that if they fail the entrance exam An Xiaokang will join the army and his brother will study to be a chef.

"When they're gone we won't plant the fields any more, it's too difficult without the people," he says, smoking a roll-up cigarette and watching the television. The old folk think the only hope for the younger generation is to leave.

An Xiaokang's family only has one cistern, in the yard. "It's not a good one," he says, the water's dirty, and they usually just use it for the livestock. Once a week he and his brother pull carts to a well at the border of Licha and Panjiagou and bring back two 50 litre barrels of drinking water.

There was a hailstorm on the night of December 24, 2016, and when An Xiaokang woke up on the 25th the road was slippy and covered with pellets of ice. That was a Sunday, usually the day students head back to their schools, and the day they go to collect water. But the frozen road meant the trip to collect water was too dangerous.

If An Jianhua had the choice he'd move the whole family somewhere flatter and closer to water. Then when his grandchildren left home his son and daughter-in-law could find some light work on the outskirts of the city. He doesn't understand why Licha has been overlooked in the relocations.

Life in the new town is not for everyone. Jobs are scant and opportunity seems to lie elsewhere in far-away cities. The freshly built identikit houses may be built to last but at the same time seem so temporary.

Kang Ning is a reporter for The Paper.

牛从水池取水饮用

Cattle drink from a water pond

村民依靠储存在地下蓄水池中的雨水来获得饮用水

Villagers rely on rainwater stored in underground cisterns for drinking wate

一些村民宁愿留下来而不搬迁

Some villagers prefer to stay put than be relocated

中国煤炭消费顶峰过去了吗？

China's coal consumption drops for third year in a row

中国煤炭消费量和生产量皆实现连续3年下降，且下降率双双再创新高，似乎给煤炭消费已于2014年前后达峰的看法提供了重要证据。按照国家统计局数字，中国煤炭消费量在2014年首次下降 2.9% 后，相继于2015年和2016年继续降 3.7% 和 4.7%。而2017年中国煤电行业还将面对更加狭小的生存空间，1月份出台的叫停措施将让目前中国各地规划中的煤电装机总量直接减半。

New research reveals that China burned 4.7% less coal in 2016 than in the previous year, has dropped for the third consecutive year since 2014 , coal consumption dropped 2.9% and 3.7% year-on-year in 2014 and 2015, respectively, ending a streak of rapid consecutive growth from 2000 to 2013.The new data consolidates a view among energy sector observers that China' s coal consumption already past its peak before 2014, much earlier than previous projections that placed it between 2020 and 2040. China cancelled many power projects in 2016 but the sector looks set to get squeezed further this year , latest cancellations have halved planned coal power construction in the country.

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